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The Welding Engineer

Reg. U. S. Pat. Office

Volum[illegible] 19 | September, 1934 | Number 9

multi-flame welding
fuses together the
halves of a receiver
making a strong,
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(See Page 28)

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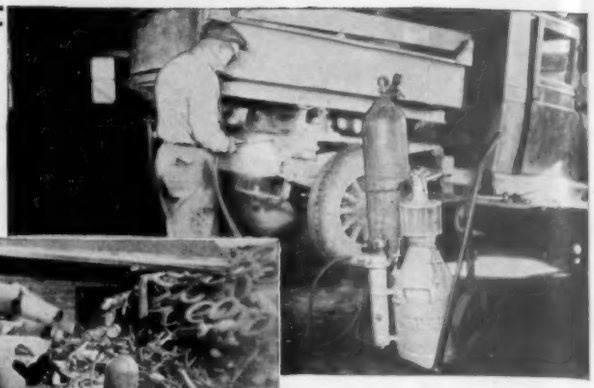

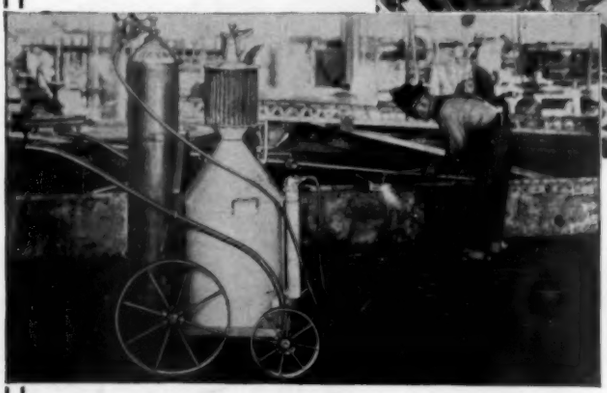

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THE WELDING ENGINEER

LEADING ARTICLES IN THIS ISSUE

SEPTEMBER, 1934

Vol. 19. No. 9

Cast Iron (Page 25)
Cast-Iron Arc-Welding of Wobbler Ends of Strip-Mill Rolls (Phillips)

Structural Steel (Page 26)
All-Welded Steel Frame Buildings for Leland Stanford University (Archer)

Machine Gas Welding (Page 28)
Welding of Refrigerator Parts (Monroe)

Electrodes for Resistance Welding (Page 30)
Making Dependable, Speedy, Economical Resistance Welds (Perkins)

A. W. S. Meeting—Metal Congress (Pages 32-36)
New York Will Play Host to Metal Congress
Program of Fall Meeting, American Welding Society

Welding Generators (Pages 38 and 45)
Evolution of Welding-Generator Design—II (Hansen)
Multiple-Operator Welding Sets or Single-Operator Sets—Which? (Jones)

Welding as an Adjunct to Plant Operation (Page 42)
Applying Welding to the Construction and Repair of a Wide Variety of Plant Equipment (Collins)

Editorial—(Page 23)
British Now Accept Welded Pressure Vessels (Blackall)—(Page 27)
International Acetylene Assn. to Meet in Pittsburgh—(Page 33)
Get H. O. T. on Welding—(Page 36)
Welding News in Pictures—(Page 37)
Chemical-Tank Explosions Prove Fatal to Welders—(Page 41)
Cleaning and Repairing Underground Pipelines—(Page 44)
Welded Oil-Field Equipment Built Up From Piping (Rogers)—(Page 48)
Retaining Strength and Ductility in Manganese Steel (Slibeck)—(P. 48)
New Equipment—(Page 49)
Trade Literature—(Page 52)
Commercial News—(Page 52)
Notes From the Field—(Page 54)

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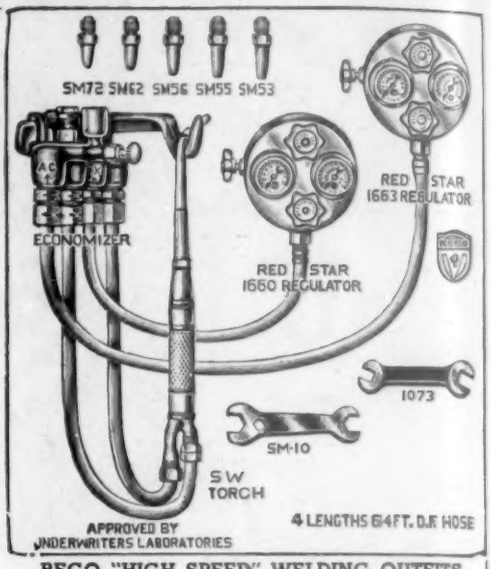

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INDEX TO ADVERTISERS

	PAGE
A	
Air Reduction Sales Co.	22
Adams Co., J. D.	Rear Cover
Aladdin Rod & Flux Mfg. Co.	66
American Arc Welders	8
American Brass Co., The	55
American Steel & Wire Co.	7
Anti-Borax Compound Co.	64
Arcos, Inc.	58
B	
Bastian-Blessing Company, The	6
C	
Carter-Lockard Co.	60
Central Steel & Wire Co.	57
Champion Rivet Co.	64
Churchward Engineering Co.	66
Commercial Acetylene Supply Co., Inc.	63
D	
Decatur Casting Co.	64
E	
Electric Arc Cutting & Welding Co.	18
F	
Fibre Metal Products Co.	61
G	
General Electric Co.	12-13
General Electric X-Ray Co.	58
H	
Handy & Harman	10
Harnischfeger Corp.	17
Hobart Bros.	3
Hollup Corp.	15
I	
Ideal Face Shield Co.	66
Illinois Steel Co.	19
Imperial Brass Mfg. Co.	60
Innis-Speiden & Co.	58
International Acetylene Ass'n	16
International Nickel Co., Inc., The	24
L	
Lincoln Electric Co., The	9
Linde Air Products Co., The	11
M	
Maurath, Inc.	Inside R. C.
Metal Bond Manufacturing Co.	66
Milburn Co., The Alexander	66
N	
National Carbide Sales Corp.	57
National Glove Co.	59
National Metal Congress	14, 20
R	
Resisto-Loy Co.	56
Revere Copper & Brass, Inc.	21
Roebling, John A., Sons Co.	4
S	
Safety Gas Lighter Co.	66
Seneca Wire & Mfg. Co.	63
Shawinigan Products Corp.	64
Shoot-A-Lite Corp.	64
Sight Feed Generator Co.	Inside F. C.
Steel Sales Corp.	65
Stoody Co.	65
Stulz-Sickles Co.	64
T	
Tillman Co., John	64
Torchweld Equipment Co.	61
Torit Manufacturing Co.	66
U	
Universal Power Corp.	56

· E D I T O R I A L ·

Getting the Most Out of Welding Displays

● The most valuable contribution that the manufacturer of welding equipment and supplies can make toward the success of shows and welding conferences does not necessarily lie in an attractive educational display and demonstration on welding or cutting; but it is in the direction of personal contact with users of the welding processes that the manufacturer can make his best contribution to the field. ¶ The salesman or engineer who has a store of valuable information at hand and is blessed with the knack of imparting that knowledge, with clearness, to others, is a most valuable representative of the manufacturing or distributing establishment with which he is connected. Above all others in the organization, he should have first place when men are chosen to attend conferences and exhibitions. The sales promotion department can prepare the finest kind of educational display, but unless the men who administer the booth and meet the public show that they really have a knowledge of the equipment they are offering and show a sympathetic understanding of the problems put up to them by visitors, the displays and demonstrations will not mean much, and a big opportunity to render valuable service to the industry is passed up. This matter of choosing personnel to man booths should not be passed up lightly. ¶ The visitor himself should take full advantage of the opportunity to meet those whose training and experience make them peculiarly fitted to discuss the equipment on display and to offer suggestions and explanations with reference to welding problems. Even the visitor who has no "problem" can often pick up a suggestion that will result in savings or in a better product. ¶ If both the manufacturer and the user of welding equipment and supplies are to receive full benefit from shows and conferences, those who man the booth must keep the interests of both in mind. Hence, manufacturers and distributors should give careful consideration in selecting the men who will represent them.

Welding Shops Can Help in Making the Truck-Trailer Safe

● Because of broken or disconnected couplings, trailers are becoming a menace to lives and property. Here is an opportunity for the welding shop to be of service to the safety movement, by insisting that the manufacturing or repairing of couplings be accorded only first-quality work and that the design be such as to insure against accidental uncoupling and against breakage. The job welding shops are getting many couplings for repair, and in some cases they are manufacturing couplings under contract. Hence, they have a heavy responsibility in this matter. ¶ The need for a safety movement along this line was impressed upon *The Welding Engineer* when recently one of the magazine's field representatives was forced into a ditch to avoid being hit by a trailer that was running wild after having broken loose from its truck. ¶ Another recent case involves a job welding shop. While entering the plant of the Miller Welding Co. in Toledo, a truck-trailer became uncoupled, and the trailer ran wild and demolished a 1½-ton bakery truck. Such occurrences are becoming more and more common. Reliable design and construction is the only solution.

The Last Call to See the Biggest Show on Earth

● It is opportune at this time to mention that after October 31st, A Century of Progress (Chicago's World's Fair) will be no more. On November 1st, workmen will start demolishing the Fair buildings and tidying up the spaces left vacant so the 3-mile tract of land can be turned back to the South Park Board in condition for park use. The Fair has contributed mightily to spreading knowledge about welding and cutting and has demonstrated to many millions of visitors that welding is a reliable, economical means for fabricating steel structures. Many of the exhibits at the Fair will be moved to the Museum of Science and Industry, located in Jackson Park, Chicago. Some of the buildings put up by individual exhibitors may remain. What disposition will be made of the Sky-Ride towers has not yet been decided upon. ¶ The Fair provided a common stamping-ground, where the welding industry learned much and gave much in return. When the final curtain is dropped on the night of October 31st, all who are interested in the advancement of welding knowledge and technique will applaud the vision of hope and confidence that brought about the Fair and carried the plans through to success, and will entertain the hope that the next Fair, wherever it may be, will also be a monument to industrial progress and vision, in the making of which the welding and cutting processes will play an impressive creative part.

AN ADVERTISEMENT FOR NICKEL-BEARING WELDING RODS MANUFACTURED BY THE INTERNATIONAL NICKEL COMPANY

"I Cover The Welding Front

...and Wilter Wanchell has nothing on me"

NICK RODDER

SINCE my last letter on the subject of my journeys, I've been traveling high, wide and handsome. Everything has come my way from plastic jewelry to the kitchen sink.

This plastic business is spreading fast. "Synthetic resins" the lab boys call their stuff, and they turn it into telephone receivers or false teeth or what have you? It's a poor month goes by but what some new fabricator of plastic-making equipment gets the boss on the wire and tells him "Can Nick come right over?" Of course I can. And do.

Last time it was four 46" steel jacketed nickel pressure kettles with cast nickel agitators. All four had hemispherical bottoms, straight sides, and domed tops. The forming and welding of these kettles and of their conical vapor removal pipes, looked at first about as complicated as a jigsaw puzzle. But we got it licked.

This was a gas job. Oxy-acetylene was the only equipment on hand. I showed that nickel can be welded by gas or by *any* of the methods used on steel. Provided you watch a few small points:

For one thing, no flux. Only bare nickel welding rod for gas-welding nickel. And for another thing use a slightly higher heat than for similar construction in steel.

"Nothing to it," said the welders on the job. They caught on so quick I hardly had anything at all to do but sit down and chin while they ran through their work.

Blonde Trouble

One of our custom sink builders was having blonde trouble recently, and as in all such cases I am considered something of a Dr. Fixit, the boss sent me down to help them out.

In this case, they were forming their sinks out of 18 gauge Monel Metal and soft soldering the joints. The solder joints, when first made, were a nice platinum blonde color. But after short service they turned a dark brunette shade that didn't match the rest of the job at all—and besides, they were too weak.

Here's what we did: First, set up butt and corner joints with clamps. Then painted edges of sheet with Inco Gas Welding Flux in paste form. That improves the fluidity of the molten metal and at the same time prevents discoloration.

The clamps kept the light gauge sheets from buckling. I used a small oxy-acetylene welding torch and built a neat, flat bead with a uniform weld appearance. After that operation the butt and corner welds were ground and polished, which makes a perfectly swell looking sink and one that is a lot stronger than a soldered job could ever hope to be.

Result, no more blonde joints turning brunette, and pleased customers for the fabricator. Which also makes *him* happy.

Hoping you are the same,

Nick Rodder

INCO WELDING SERVICE

INCO WELDING RODS and FLUXES

for PURE NICKEL

Oxy-Acetylene . . . "T" Nickel Gas Welding Wire.
Metallic Arc . . . INCO Nickel Metallic Arc Welding Wire No. 31.
Carbon Arc .. INCO Nickel Carbon Arc Welding Wire No. 21.

for MONEL METAL

Oxy-Acetylene . . . Monel Gas Welding Wire. For flux see * below.
Metallic Arc . . . INCO Monel Metal Arc Welding Wire No. 30.
Carbon Arc . . . INCO Monel Carbon Arc Welding Wire No. 20.

for INCONEL

Oxy-Acetylene . . . Inconel Gas Welding Wire. For flux see ** below.
Metallic Arc . . . Inconel Metallic Arc Welding Wire No. 32.

for NICKEL-CLAD STEEL
(for welding of Nickel side)

Oxy-Acetylene . . . "T" Nickel Gas Welding Wire.
Metallic Arc . . . INCO Nickel Metallic Arc Welding Wire No. 31 and No. 85‡
Carbon Arc . . . INCO Nickel Carbon Arc Welding Wire No. 21.

•

FLUXES

*INCO Gas Welding and Brazing Flux for Monel Metal.
** "Cromalloy" Gas Welding Flux is recommended for Inconel.
‡ For vertical welding.
No flux is used for the gas welding of Pure Nickel or Nickel-Clad Steel.

•

INCO welding materials as listed can most conveniently be obtained through regular INCO distributors.
Detailed welding instructions furnished on request.

THE INTERNATIONAL NICKEL COMPANY, INC., 67 WALL STREET, NEW YORK, N. Y.

The Welding Engineer

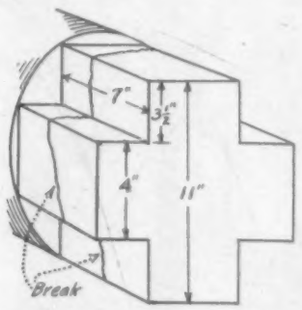
VOLUME 19 SEPTEMBER, 1934 NUMBER 9

Cast-Iron Arc-Welding of Wobbler Ends of Strip-Mill Rolls

■ By C. E. PHILLIPS
C. E. Phillips & Co.

TWO strip-mill rolls of cast iron with a slight chrome content, each having a fractured wobbler end, were recently repaired in a total time of approximately six hours, using the arc-welding process.

The two wobbler ends were broken at practically the same place, as shown in the diagram. Instead of V-ing out and welding at the place of fracture, the rolls were placed in a lathe and the wobbler ends cut down to the bearing and new wobbler ends built up by depositing weld metal.



Dimension Drawing of Wobbler End, Showing Approximate Location of Break.

After leaving the lathe, the rolls were placed on end to provide a flat surface on which to make the deposit, a suitable scaffold was erected for the operators, and in each case the roll end on which the deposit was to be laid was heated with three large oxyacetylene welding torches for approximately 20 minutes, bringing the metal up to approximately 1400° F.

ONE hundred and forty pounds of electrodes was deposited by four operators in one hour and twenty minutes, without preheating. The deposit was soft and easily machined.

The welding operations were then started, using four men and four arc-welding machines operating at approximately 450 amperes. Each of the operators was assigned to one of the four pods of the wobbler, with all alternately applying metal to the center section. Arcast rod of three sizes—$\frac{5}{16}$, $\frac{3}{8}$ and $\frac{1}{2}$ in.—was used, the different sizes being necessary to allow proper control of the heat.

Two Wobbler Ends Completely Built Up by Arc Welding.

Strip-Mill Roll with Badly Worn Wobbler End, Showing Pod Broken Off.

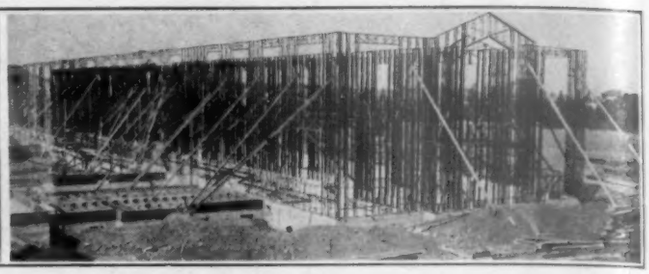
The actual welding time on the first roll was 1 hour 55 minutes, and the second roll required only 1 hour 20 minutes. A total of 140 lb. of Arcast electrodes was deposited in the actual welding time of 3 hours 15 minutes. The total time for setting up and welding was approximately six hours.

The welding was done in a manner requiring practically no machine work on the wobbler ends after welding. The deposited metal was carefully checked and found to be soft and easily machined at any point.

In another type of repair on wobbler ends, a broken-off pod was rebuilt and the worn surfaces of the other pods built up 1 in. The time required for the actual welding by two operators and one helper was 1 hour 20 minutes, using 40 lbs. of Arcast electrodes.

In all these cases, it was necessary that all the deposited metal be free from hard iron and that it machine easily. No difficulty was experienced in machining any of the deposited metal where machining was necessary.

One of Four Dormitories Having Welded Steel Frames.



Steel Frame Erected, Ready to Receive Floor and Roof Joists.

All-Welded Steel Frame Buildings for Leland Stanford University

■ By W. E. ARCHER
Staff Correspondent, The Welding Engineer.

THE recent construction of the Lagunita Court, at Stanford University, in Palo Alto, Calif., entailed the use of all-welded steel frames. In this project there are four large dormitories and one separate kitchen. The dormitory buildings are 42 ft. 6 in. wide and two stories high. Two of these buildings are 156 ft. long, the other two are 209 ft. long.

The first-floor construction is steel truss joists supporting 2x4-in. sleepers with centers spaced 17 in., placed at right angles to the joists. On top of these sleepers are the sub-floor and a hardwood flooring.

The second floor is also supported on steel truss joists. The ceiling of the first story is attached directly to the bottom chord of the joist and is composed of one layer of 1-in. Thermax with the plaster applied directly onto the Thermax. Above the steel joists are 2x4-in. sleepers, spaced 17 in. on centers, supporting the 1-in. sub-floor, ½ in. of Celotex, and a hardwood flooring.

The ceiling of the second story is composed of steel truss joists supporting Bar-X metal lath and plaster.

Arc-welding was employed exclusively in this work, which was done by the Soule Steel Co., of San Francisco, Calif.

There are many advantages in this type of construction, among which are:

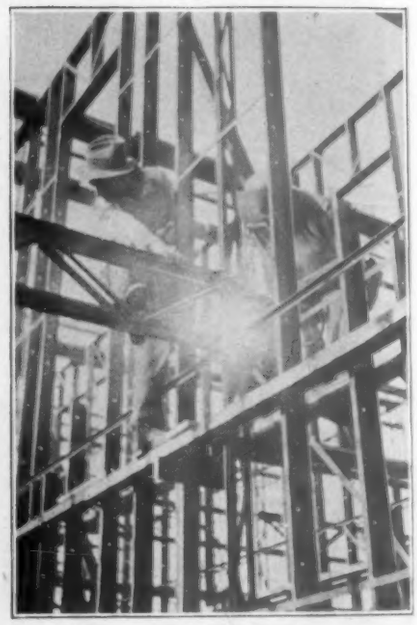
(1) The fire hazard is minimized, thereby obtaining the low fire insurance rate of 57 cents per $100 per year, as compared to 90 cents per $100 on wooden frame construction, or 70 cents per $100 on wooden frame construction with sprinkler system.

(2) This type of construction is admirably adapted to earthquake-resistance design, where lateral forces are involved. The welded steel construction has a certain amount of flexibility, which prevents sudden ruptures due to violent earthquake stresses. Moreover, all stresses can be accurately determined —something impossible with wooden framework and nailed connections.

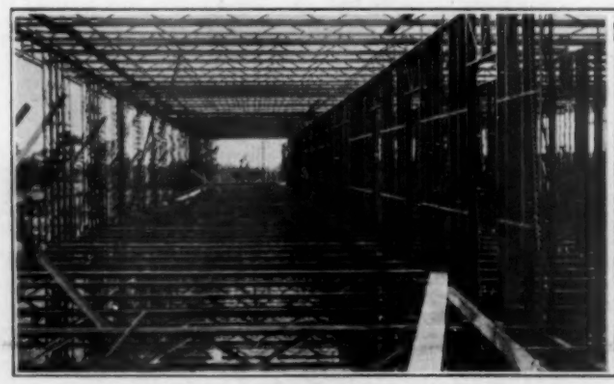
(3) The termite hazard is entirely eliminated.

(4) Shrinkage, one of the worst problems confronted by the architect, builder and owner, is entirely eliminated.

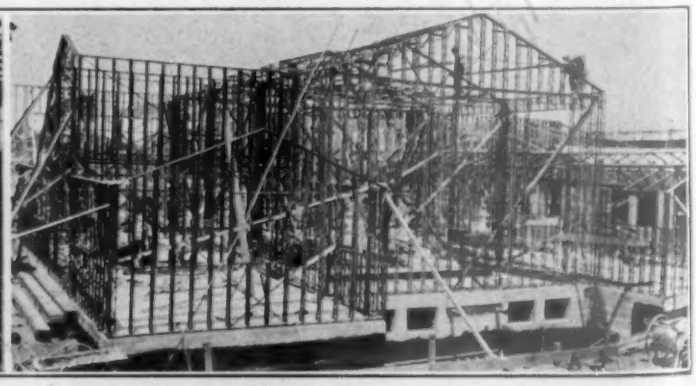
(5) Adequate space is provided for conduits and plumbing through the joists, or through the open-web stud system.



Welding Steel Joists in Place.
(Small horizontal continue angle at bottom of joist insures an absolutely level bearing for all floor joists.)



Looking Through One Wing at Second Floor.



Steel Frame Erected for Kitchen.

(The view at the left, looking through a dormitory wing, was taken before the installation of the cross partitions. Note the window openings in the outside wall and the door openings along the corridor walls.)

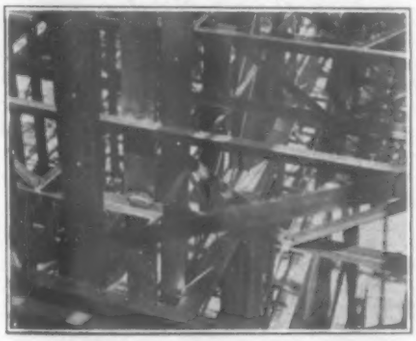
(6) The time of erection is greatly reduced, due to the fact that the walls are made up in panels in the shop and are ready to be erected immediately upon arriving at the job. This greatly reduces the job overhead.

The exterior frames are all-arc-welded trussed studs made up in panels of sizes to handle conveniently in the field and with openings provided for windows and doors and recesses under the windows for radiators. All shop and field connections, including attachment of bracing, are arc-welded. The studs are two stories high, running from the foundation to the eaves. A ledge is provided at the second-floor line to support the second-floor joist.

Interior frames are also arc-welded. This partition is 4 in. thick, the intermediate studs being formed of cold-rolled channels and the main studs at the line of the cross partitions consisting of 4-in. arc-welded trussed studs similar to those in the exterior walls. The studs at the line of the cross partitions are made heavier as they are to provide additional strength to absorb earthquake stresses.

The channels are approximately 10 ft. 6 in. wide by two stories high with openings provided for doors, hose reels, cabinets, etc. These frames are sufficiently welded and are adequately braced to sustain all the loads which it is contemplated they may be called upon to carry.

The floor joists are all Soule Steel Co.'s arc-welded steel joists of determinate truss design. All panel points



Details of Welded Connection of Floor Joists to Corridor-Wall Studs. White Marks Indicate Welds.

have sufficient welding to fully develop the stresses in the members connected. The main joists are all 42 ft. long extending from out to out of building, and are welded to the interior bearing walls as well as to the exterior walls. This provides a system of wall and floor framing all definitely and rigidly connected together.

Erection of the four dormitories and kitchen commenced May 1st and was completed during June. All material of steel construction in these buildings was supplied by the Columbia Steel Co., of San Francisco.

British Now Accept Welded Pressure Vessels

By GEOFFREY BLACKALL

A most important advance in the acceptance of fusion welding technique in the United Kingdom is represented by the recent issue of a specification relating to fusion-welded pressure vessels for land usage by Lloyd's Register of Shipping. This publication of the requirements of Lloyd's Register, regarded internationally, is not of course a pioneer effort. However, the Register is the first important insurance body in Britain to take so progressive a step.

The first noteworthy point in the specification is that the term "fusion welded" is defined as applying only to types of welding in which the parent metal and the weld metal are at all times protected from atmospheric contamination. The specification accepts the oxyacetylene or the oxy-hydrogen process, the metal-arc process with covered electrodes, or any other electric-arc process in which the arc stream and the deposited weld metal are shielded from atmospheric contamination.

Another notable feature of the specification is the distinction it draws between fired pressure vessels subject to internal steam pressure above 50 lb. per sq. in. (Class 1 vessels), and pressure vessels not included in this category (Class 2 vessels).

An X-ray test is called for in connection with the welding of Class 1 vessels. It is first required that any concern desiring to be ranked as competent to undertake Class 1 work, after having satisfied Lloyd's Surveyors that it is properly organized for the execution of welding work of that grade, shall carry out a number of qualifying tests. Among these is the submission of X-ray photographs of portions of the test plate welds, together with photomicrographs of the weld metal, fusion zone, and plate, and these are placed on record by Lloyd's Register.

In the case of Class 1 vessels, X-ray photographs are to be taken of the entire length of each welded seam, both longitudinal and circumferential, the pictures being marked for identification with the parts of the seams. The X-ray methods employed are required to be of such accuracy as to reveal any defect having a quantitative thickness greater than 2% of the depth of the weld, this being checked by a negative supplied by the manufacturer. Defects revealed by the X-rays are to be cut out, re-welded, and again X-rayed.

The following seven separate tests are required of the welds themselves: (1) A tensile test of an all-welded specimen cut from an extended portion of the welded joint; (2) a bend test taken across the weld; (3) an impact test taken at the junction of the weld and the parent metal; (4) an impact test of the weld metal itself; (5) a tensile test taken across the line of the joint; (6) a test of the specific gravity of the weld metal, which is not to fall below 7.8; and (7) various photographic tests.

One photomicrograph of 100 magnifications is to be taken at four points on a cross-section of the parent metal and weld, as follows: In the parent metal remote from the weld, in the parent metal close to the weld, in the fusion zone, and in the weld metal. The photomicograph is required to show a sound, homogeneous weld and a normal refined and uniform grain structure.

Class 2 vessels are accepted if made with fusion-welded joints satisfying materially less stringent requirements than those outlined above for vessels of Class 1. For example, X-ray testing is not specified, reliance being placed on an overload hydraulic test, which test must also be carried out on Class 1 vessels in addition to the X-ray tests.

This specification appears to bring the British welding industry into line with the welding industries of the United States and Continental Europe with respect to pressure-vessel construction, and to provide British welders with a long-delayed opportunity of proving the worth of the claims which they have been making for several years past.

Dr. Jacobus Addresses Los Angeles Section

The first fall meeting of the Los Angeles section of the American Welding Society, following the usual summer vacation, was scheduled for Tuesday evening, Sept. 18th, at the Los Angeles Athletic Club. This was a joint dinner conference in conjunction with the American Society of Mechanical Engineers and was given in honor of Dr. David S. Jacobus, president of the American Welding Society and past president of the American Society of Mechanical Engineers.

According to the program, Dr. Jacobus addressed the meeting on the subject, "Modern Developments in Welding." Interesting lantern slides were shown in connection with the talk.

Dr. Jacobus is advisory engineer for the Babcock & Wilcox Co. and is the chairman of the Boiler Code Committee of the A. S. M. E. He has a vast fund of knowledge on the subject of welding and its application, particularly in connection with pressure vessels, boilers and such structures as the Boulder Dam penstocks.

An ingenious torch welding machine and conveniently operated jigs for clamping the work, make for economy and speed in the

Welding of Refrigerator Parts . . .

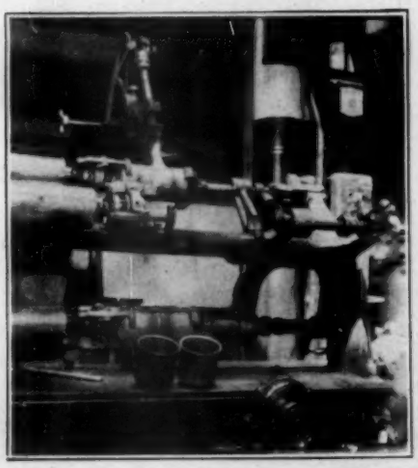
By L. C. MONROE
Staff Correspondent
The Welding Engineer

Soldering Cooling Units for Norge Refrigerators

A HIGH degree of ingenuity and skill in the applying of welding to the manufacture of domestic refrigerators is evident in the plant of the Norge Corporation at Muskegon Heights, Mich. Here the welding blowpipe is used for making parts in the freezing units, fabricating the cabinets, and for soldering during the assembling of the freezing units.

Special Machine for Welding Receiver Shells

It is in the producing of the parts of the cooling device—more especially, the receiver shells—that particular skill has been demonstrated. A specially developed machine is used by which the circumferential seams of these shells are



Welding 100 Shells Per Hour With a Multi-Flame Torch.
(In the foreground are two halves of a shell ready to be inserted into the work cradle and swung into the preheating and welding flames.)

welded at the rate of 100 per hour; some of the operations are performed automatically and the human element is largely eliminated. This machine, which was developed by N. G. Copely, tool engineer of the plant, is highly efficient and produces neat welds of high quality, which consistently withstand pressure tests of 400 lb. per sq. in.

These receiver shells are really reservoirs, and constitute the starting and

The Shells Are Held in a Jig While Brackets Are Welded On.

finishing point of the circulating refrigerant. Each shell is constructed of one-pass cold-rolled 14-gage metal, stamped in two halves, each 4½ in. in outside diameter. The shell, consisting of two halves joined together, is 9½ in. long.

The machine has a work cradle consisting of Y-shaped frames supporting three sets of jaws made of "Misco" metal, a heat-resisting chrome-nickel alloy. Each set of jaws holds the two halves forming one of the shells.

Shells Are Preheated Before Welding

The welding operation is performed in three steps. First, the operator inserts two halves of a shell into the set of jaws nearest him, and lines the work up. Next, he revolves the cradle downward, one-third of a revolution, which brings the parts into the flame of a preheating torch burning a mixture of city gas and compressed air; in this position, the parts are spinned rapidly, the speed being controlled by the operator, thus assuring uniform heating. Another one-third revolution of the cradle places the seam of the shell within range of the flames from a six-flame Oxweld machine welding blowpipe, where the part is made to revolve much slower than when in the preheating position, a complete revolution of the part being made in 40 to 45 seconds. This last operation completes the weld, and the operator turns the cradle another one-third revolution, which brings the completed shell around to the operator, who removes it from the jaws and inserts another pair of shell halves.

Each time the work cradle is turned a third of a revolution, the operator removes a completed shell and inserts two halves to be welded together. The same turning operation moves a shell into the preheating flame, and the shell that had just been preheated is advanced into the welding flames.

Torch Fuses Flanged Edges Together

The welding operation consists merely of fusing together the flanged edges of the shell halves, no filler rod being required. The welding head is equipped with No. 2 tips, and both it and the blowpipe are water-cooled. (See illustration on front cover.)

The work cradle is locked in its three positions. To revolve the cradle, the operator must press a pedal, releasing the cradle.

Before preheating was adopted in this operation, many of the welded shells were rendered defective by the forming of fine hair-line checks alongside the weld and running at right angles to the weld. It was thought that these checks were due to the drawing operation in flanging and not caused by the welding. In draw-

ing the halves, the edges are flanged outward, stretching the metal and setting up high stresses. The effect of the preheating operation is to reduce these stresses or remove them altogether. No difficulty has been experienced since including this step in the procedure.

Before the two halves of a shell are assembled for welding, one of the halves is set on a revolving jig and an insert is brazed into the end, the operation being performed with a hand torch and Tobin bronze.

Each shell, after leaving the welding machine, has two brackets welded on, this operation being performed on a jig. The shell is then tested with sulphur dioxide at 150 lb. pressure, which is in addition to the occasional 400-lb. test already mentioned.

Refrigerator Linings Are Welded in Jigs

Welding is also used to fabricate the inner lining of refrigerator cabinets. Each lining consists of a 3-sided box formed from one plate, with ends welded on, leaving one side open for the refrigerator door. Machines containing two jigs apiece were devised for the welding of these box-shaped linings. One of the linings, with its ends, is set up for welding in each jig, allowing each machine to accommodate two of these boxes.

Each jig consists of two water-cooled plates, the lower one being stationary while the upper one can easily be raised by means of a counterweight. The end piece to be welded to the box is held rigidly in place between these two plates. The cabinet is held solidly in its proper position by means of a bar which clamps it on three sides.

With the end in place, only a little of the corner shows, which is sufficient for welding. When used as food compartment liners, these boxes are made of 18 and 20 gage metal, the former size being used for the larger models. Some of these liners contain as much as 108 in. of welding on each end.

Two welders are used on each jig. They jointly set up the work, and both start to weld in the middle of the back seam, each man then working around and welding his side of the box. The welding torch melts down the edges and fuses them together. Generally, filler rod is not used except when finishing the weld at the corners.

When the first end has been welded, the welders remove the side clamp and the top plate, slip out the box, reverse it, and set it up for welding the other end, in the same manner in which the first end was welded. Only a few seconds are required to reverse each box.

With both ends welded to the liner box, it is sent to another welder who welds two lugs onto the ends. These lugs are to facilitate handling the liner through the furnace and are later removed.

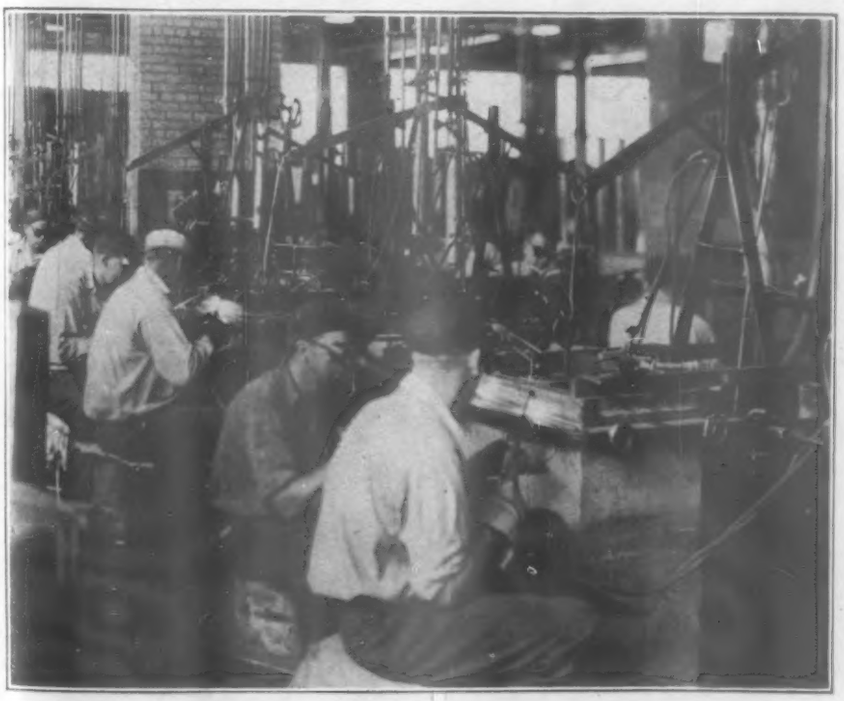
Progressive Application of Lower-Melting-Point Solders

Torches are also employed for the assembly of the cooling units. Forty girls are engaged in the operation of soldering these parts together, using Weldit torches with No. 5 tips reamed out to No. 7 orifice. Oxygen at a pressure of 20 lb. and city-gas pressure equal to 12 in. of water are used.

The first step in the assembly operation is the soldering of the ends of 13 copper tubes into brass headers. Each girl completes between 16 and 20 of these tube-and-header assemblies an hour. On this, the first operation, a high-melting-point solder is used, and on each succeeding operation a solder of somewhat lower melting point is employed. In this way, no soldering operation will require such heat as to melt any of the joints previously soldered. Jigs play an important part in lining up the work; they hold the parts in place and retain the solder so that it will not run through and clog up the lines. Many of these jigs are air-operated.

These torch-soldered assemblies are tested with an air pressure of 325 lb. Fewer than one-quarter of one per cent of these assemblies show leaks, reports Mr. Copely.

Experiments were made with various gases for soldering. Oxyacetylene was found to be too hot, while city gas and air gave a flame that was too large and not concentrated enough. City gas and oxygen have proved ideal.



Welding Ends on Linings of Refrigerator Cabinets.

Gas-Welding Code Authority Elects Ten Members

At a meeting of the National Oxygen & Acetylene Association held in Chicago Sept. 11th, ten members were elected as the supervising agency, which is the Code Authority for administrating the gas-welding code.

Five members elected on the basis of sales volume were: J. D. Swain, vice-president, The Linde Air Products Co.; G. B. Walker, vice-president, The Linde Air Products Co.; J. H. Rodger, vice-president, Oxweld Railroad Service Co.; W. C. Keeley, assistant vice-president, Air Reduction Sales Co.; and C. D'W. Gibson, general sales manager, Air Reduction Sales Co.

Five additional members elected by numerical vote were: Parker B. Francis, president, Puritan Compressed Gas Corp., Kansas City, Mo.; D. J. Will, vice-president, Stuart Oxygen Co., San Francisco, Calif.; C. E. Engler, president, The Balbach Co., Omaha, Nebr.; R. B. Swope, president, Southern Oxygen Co., So. Washington, Va.; and R. R. Dickson, president, Carbo-Oxygen Co., Pittsburgh, Pa.

Cleveland Technical Groups Cooperate on Programs

The chairmen and secretaries of the technical and semi-technical organizations in the Cleveland district held a meeting on Sept. 5th, so each might become acquainted with the plans and objectives of the other groups and render assistance in planning and correlating programs. A similar meeting was held last year with gratifying results.

The electrode material is an important factor in

Making Dependable, Speedy, Economical Resistance Welds . . .

■ By CHARLES L. PERKINS
Consulting Welding Engineer

WHEN electric resistance welding was first introduced, considerable difficulty was experienced in obtaining a proper electrode material. Much time and money were spent in an effort to develop a material that would give the required conductivity and, at the same time, withstand the necessary pressure to produce a good weld.

Copper was found to be far too soft to withstand the high pressure and high currents common to this type of welding. The electrode would mushroom under the continuous hammering, changing the current density and alignment, thus affecting the proper heating of the metals to be welded.

Electrodes made of castings were tried, but often the cast electrode was found to be porous and, whether the alloy contained silicon, phosphorus, or any material of like nature, the results were far from satisfactory and the cost was considerably higher.

Forged copper electrodes offered some improvement, but the life was not sufficiently increased to warrant the additional cost.

Attention, at this time, was focused upon water-cooling the electrode. A vast improvement was found when sufficient cooling was introduced, but this did not do away entirely with the annealing of the electrode.

Tungsten-Copper Electrodes Make Their Appearance

Obviously, an entirely new development was required. A material that would be hard enough to stand the abuse to which the welding electrode is subjected and, at the same time, allow sufficient electrical conductivity to create perfect welds, was sought not only by the welding-machine user but also by the welding-machine builder. With such a material, the scope of the electric welding industry could be widened to unlimited possibilities.

Therefore it was a relief for the entire electric-welding industry, for the builder as well as the user, when the first test was made with tungsten-copper alloy, which was approximately ten years ago.

This alloy had the good characteristic of copper with high conductivity, but the bad feature of tungsten with low conductivity, but on the other hand the hardness was many times increased and very desirable. However, in some cases mistakes were made by using this material for jobs on which it was unsuitable —for instance, as spot welding electrodes. The tungsten contained in this alloy had a bad influence, as it evaporated and made these electrodes unusable in a short time. The low conductivity of these electrodes may have had some influence in this direction. The hardness, of course, was higher than was used before. This experience naturally led to the conclusion that this copper-tungsten alloy was a superior material for butt and flash welding electrodes, as electrodes for these methods were not affected by the heat. As the result of this, many problems could be solved which heretofore had been almost impossible to develop without the use of this alloy.

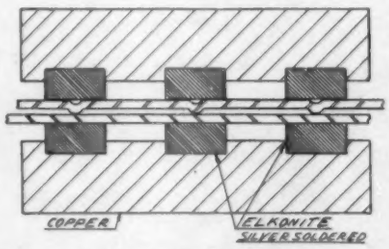


Fig. 1. Employing Copper-Tungsten Inserts for Projection Welding.

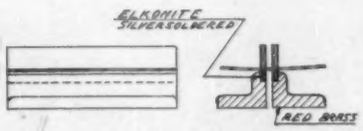


Fig. 2. Electrodes Faced With Hard Alloy to Withstand High Clamping Pressure.

Industry Adopts the Projection Welder

About 1926 the projection welder was generally accepted in industry. This method required a welding die or electrode of intense hardness; one that would stand up under high pressure without fracturing or pitting. Copper-tungsten alloy was used in the form of pads or inserts, as shown in Fig. 1, silver brazed to a copper backing die. Excellent results were obtained. Today, this method is universally used throughout the automotive industry, reducing the manufacturing costs far beyond their fondest expectations. Not only does this alloy save many dollars in time and labor in redressing the dies, but the little pads can be readily replaced when necessary. Added to savings possible through greater life, this method, which is known as cycle welding, reduces the welding time of 3 to 5 seconds with spot welding, to but a mere fraction of a second.

Such superior results were shown immediately upon the presentation of the projection welder, that the method developed with startling rapidity. Within two years, machines were built which were able to weld thirty to forty spots on $\frac{5}{16}$-in.-thick sheet metal simultaneously. Machines up to 500 kva., with a pressure of several tons per square inch, were developed for this purpose. This could never have been accomplished satisfactorily without this hard-facing material.

Only the expert, who has to deal with such problems, is able to appreciate what the welding engineer or welding-machine designer has to encounter in order to produce today's production consisting of as many as 30 welds per minute or an average of ten spots on each welding operation. The slightest impression in the electrode surface, which would most certainly occur in soft electrode material, would create hundreds and hundreds of poor welds.

Hard-Alloy Electrodes Result in Neat, Economical Welds

Not only does projection welding depend upon such hard alloys, but the same applies to the welding of stainless steel, Armco iron, and certain other materials, in the welding of which the welding cycle must be extremely short in order to prevent corrosion and discoloration, and also to maintain the ductile grain structure. The advantages when using hard alloys as such, are that dies can be operated closer to the heat zone, thereby keeping the energy required for welding at the minimum.

In welding stainless steel, electrodes faced with such alloys are used exclusively, inasmuch as copper electrodes could not possibly stand the high clamping pressure necessary. The pressure re-

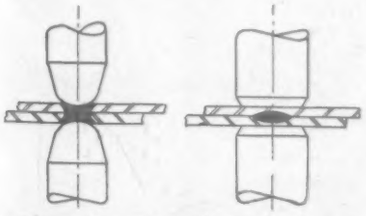
quired for welding this material is substantially higher than that used in the welding of mild steel. Fig. 2 shows how the electrodes are faced with alloy.

Added to the high pressure encountered is the thinness of the material, articles manufactured from stainless steel often being made of much thinner stock than mild steel. Therefore, the proper alignment of the electrodes is of much greater importance than when manufacturing articles of other metals, and a very hard electrode material is advisable.

Cycle Welding Follows Development in Timing

The modern spot welder, known either as a quick or cycle welder, came into the picture as soon as dependable welding controllers were introduced. These controllers permit spots to be made in a fraction of a second, similar to the projection welder, and the welds are much more dependable than those obtained by the older method of spot welding, which is shown in Fig. 3. Here again the welding engineer takes advantage of the very highly regarded copper-tungsten alloy, because the same condition occurs as with stainless steel welding—namely, the necessity of speed, lack of corrosion, and the elimination of electrode impressions. Fig. 4 explains the so-called quick welding process. Due to the fact that these welds are made within such a short time, the metal fuses between the sheets, the outside hardly having time to discolor, and the electrodes are not in contact with the welding heat.

Hand in hand with the development of the copper-tungsten alloy, experiments in metallurgical research were under way to create electrode material suitable for spot welding. The projection



Figs. 3 and 4. Spot Made by Ordinary Spot Welder (Left) and That Made by Cycle Welder (Right).

method, in spite of the rapid weld which it performed and for which such suitable material as copper-tungsten alloy was found, could not eliminate the older spot-welding method. In spite of the rapid development of the projection-welding method in the last five years, the demand for spot-welding machines has been even greater and has increased in proportion to other welding methods. The reason for this may be traced back to the introduction of the all-steel automobile body, steel furniture, etc., for which a tremendous amount of portable welding machines, welding guns and welding bars were necessary, and also for smaller production the old spot welder was still in demand. Better electrode material had to be developed for this purpose.

Cadmium-Copper Electrode Increases Production

A few years after the first alloys were introduced and generally accepted by the trade, a new electrode material came into the picture which was able to please and satisfy the demand for normal spot

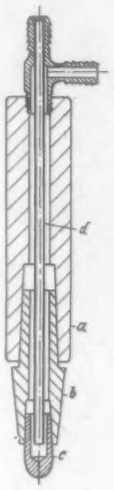


Fig. 5. Sectional Diagram of Special Water-Cooled Holder for Hard-Alloy Electrode.

(*a*, electrode body; *b*, copper adapter; *c*, electrode tip; *d*, tubing for circulating water.)

welding. This was a cadmium-copper alloy. This material, correctly applied and provided with proper water cooling, will last from five to eight times longer than any copper electrode. This not only makes a great saving in electrodes but also steps up the production considerably, due to the many hours of less filing and reconditioning of the electrodes.

Develops Electrode Holders for Automobile Welding

Some of the most prominent automobile manufacturers who adopted this alloy for their spot-welding machines, designed special electrode holders as Fig. 5 illustrates. This design consists of an electrode body *a* and an electrode adapter *b* made out of copper, which holds a smaller electrode point or tip *c* having a Morse taper. The alloy tip *c* is easy to replace. The adapter *b* is not absolutely necessary, as the tip *c* can be connected directly to the shaft *a*. Tubing *d* provides a means for water circulation and connects directly with the two-way hose connection.

Electrode material plays a much more important factor in modern industry than is generally realized. Just recently it has become apparent that great savings could be achieved by selecting the proper electrode material to obtain dependable, faster and economical welds.

Welded Oil Pipeline for California

The Standard Oil Co. of California is completing plans for the construction in the near future of a 108-mile, 12-in. welded oil line which is to extend from a point near Rio Bravo to the coast at Estero Bay. Originating in Kern County, the line will be known as the "Kern to Coast Line." The contractors for the work have not as yet been announced. This is the first oil or gas pipeline work of any importance in California thus far this year.

Safety Congress to Hold Session on Welding

Operating hazards of fusion welding and cutting will be emphasized in a special "subject" session at the Twenty-third Annual Safety Congress and Exposition, which will be held at Cleveland, Ohio, October 1st to 5th. This session, the chairman of which will be J. A. Voss, director of industrial relations, Republic Steel Corp., Youngstown, Ohio, will be directed primarily at unsafe practices in the use and maintenance of equipment.

Noteworthy among the dangers to be considered and discussed at the "Fusion Welding and Cutting" session, which will be held Tuesday afternoon, October 2nd, at the Carter Hotel, will be electric shock, toxic fumes from the welding of brass, bronze, galvanized and allied materials, and burns to the eye from infra-red and ultra-violet rays.

John Baker, supervisor of welding, Campbell Works, The Youngstown Sheet and Tube Co., Youngstown, Ohio, will outline safe practices for the maintenance and use of electric-welding equipment. He will present simple, safe practices based upon practical experience.

Reasons for caution in handling gas-welding equipment will be given by R. L. Christie, foreman of the metal shop of the Aluminum Ore Co., East St. Louis, Ill. Mr. Christie will discuss the proper method of preparing and dismantling, how repairs should be handled, and why these methods should be used; also, he will discuss periodical inspection, and safety education of operators.

The chairman of the session, Mr. Voss, is a former safety director of Republic Steel, and has made a broad study of welding questions.

The 150 delegates who are expected to attend this session may find further information on ultra-violet and infra-red burns to eyes in the talk in the "Injured Worker" subject session by Dr. Sydney Walker, Jr., opthalmologist, St. Luke's Hospital, Chicago, Wednesday afternoon, in the Statler Hotel.

New York Will Play Host to Metal Congress

Port of Authority Building at 15th St. and 8th Ave., Where the National Metal Exposition Will Be Held

MANUFACTURERS, fabricators and users of metals will congregate in New York City, Oct. 1st to 5th, for the Sixteenth Annual National Metal Congress which includes the National Metal Exposition and technical meetings of the American Welding Society, Wire Association, American Society for Metals, who are sponsors of the Congress and Exposition, American Society of Mechanical Engineers, and the Institute of Metals and Iron & Steel Divisions of the American Institute of Mining and Metallurgical Engineers.

The National Metal Exposition of this year will be the first to be held in New York City, and will hold forth in the Port of Authority Building at 15th St. and 8th Ave. A total of almost 150 firms will occupy floor space having an area nearly 50% greater than the Detroit show of last year. This Exposition will be the largest and finest since the great show of 1929, held in Cleveland. Exhibits of welding operations and welding equipment and accessories, and of welded products, will amount to about 35% of the total space in the show—a larger percentage than in previous shows—according to advance reports. All exhibits will be located on one floor. The hours of the Exposition are from noon to 10 p. m. every day, except on Thursday, Oct. 4th, when the doors will close at 6 p. m.

The American Welding Society has technical sessions scheduled for Monday to Thursday, inclusive, with inspection trips on Friday. All sessions will be held in the Hotel New Yorker, at 8th Ave. and 34th St. The award of the Miller Memorial Medal will be made on Monday afternoon, and the annual banquet, which will be a "stag" affair, will be held Thursday evening. The papers program will include such topics as alternating-current welding, structural joints, welded power-plant piping, effects of peening, results of tests of welds, resistance welding of duralumin, brazing with silver solders, metal spraying, hard-facing, flame machining, railroad maintenance-of-way work, fabricating railroad rolling stock, and qualifying and testing operators. Many of these topics are timely and will create a great deal of valuable discussion. Entertainment will be provided for the ladies.

Thirty-seven papers are listed on the American Society for Metals program, the morning sessions of which will be held in the Hotel Pennsylvania, located on 7th Ave. from 32nd to 33rd St., and the afternoon sessions in the Port of Authority Building. Of interest to men in the welding field is a paper on "Studies on the Metallurgy of Arc-Deposited Weld Metal," by S. L. Hoyt, of the A. O. Smith Corp., Milwaukee, which will be given at 2 p. m., Thursday in the Port of Authority Building.

The American Institute of Mining and Metallurgical Engineers will have their headquarters in the Hotel Pennsylvania. The Wire Association meetings will be held in the Hotel New Yorker.

The program of the American Society of Mechanical Engineers includes two papers by outstanding metallurgists. One of these is on "Non-Ferrous Metals, Today and Tomorrow," by Dr. Zay Jeffries, consulting metallurgist, Aluminum Co. of America, and the other is entitled "Iron and Steel Today and Tomorrow," and will be given by Robert S. Archer, Metallurgist, Republic Steel Corp.

Of special interest to those in the welding field will be the exhibits by the following firms, including their booth numbers and equipment on demonstration and display:

Displays Related to Welding

Air Reduction Sales Co., Booth 378. Welding and cutting apparatus, regulators, oxygen and acetylene.

American Brass Co., Booth 301. Welding rods; copper products.

American Steel & Wire Co., Booth 142. Welding wire; demonstration of welding on carbon steel and stainless steel.

The Bastian-Blessing Co., Booth 325. Welding and cutting torches, regulators, oxygen and acetylene manifolds, acetylene generators.

Eisler Engineering Co., Inc., Booth 442. Spot welders.

General Electric Co., Booth 416. Electric welding machines.

General Electric X-Ray Corp., Booth 393. X-ray equipment for metallurgical testing.

Harnischfeger Corp., Booth 488. Electric arc welders.

Haynes Stellite Co., Booths 162 and 313. Demonstrations of red-hardness and abrasion resistance of Haynes Stellite.

Hobart Brothers Co., Booth 105. Electric arc welders.

Hollup Corp., Booth 381. Welding electrodes; electric arc welders.

Illinois Steel Co., Booth 142. Alloy steels; stainless and heat-resisting steels.

International Nickel Co., Booth 130. Nickel and nickel alloys.

Kelley-Koett Manufacturing Co., Booth 173. X-ray equipment for metallurgical testing.

The Lincoln Electric Co., Booth 102. Demonstration of automatic carbon-arc

and manual welding, including welding of various metals and alloys; demonstrations of two new electrodes and of a new welder; welding accessories.

The Linde Air Products Co., Booths 162 and 313. Demonstrations of new oxyacetylene machine for cutting and for heat-treating and flame machining; demonstration of multi-flame Lindewelding and of a new type of welding blowpipe.

Magnaflux Corp., Booth 330. Methods for inspecting welds.

Metal & Thermit Corp., Booth 383. Thermit welding materials and equipment; welding wire.

Page Steel & Wire Co., Booth 475. Welding wire.

John A. Roebling's Sons Co., Booth 398. Welding wire.

USL Battery Corp., Booth 381. Electric arc welding machines.

Una Welding & Bonding Co., Booth 476. Electric arc welding machines.

Westinghouse Electric & Manufacturing Co., Booths-436 and 479. Demonstrations of spot welding with automatic time control, and of arc welding with alternating and direct current; display of x-rays of welds and of an automatic welding head.

Wilson Welder & Metals Co., Inc., Booth 378. Electric welding machines.

Philadelphia Section Plans Lecture Course

The program of the Sept. 17th meeting of the Philadelphia Section of the American Welding Society included an address by Frederick Wilson, M.D., president of Willson Products, Inc. on "Eye Protection in Welding Operations," and an outline by H. R. Salisbury of a course of six lectures on welding to be given under the auspices of the Section, with Frank P. McKibben, consulting engineer, and Dr. T. Holland Nelson, consulting metallurgist, The Midvale Co., as lecturers.

This course of lectures is open to members of the Philadelphia Section and to any others who are interested. The enrollment fee is $10, and arrangements have been made so those enrolling can become associate members of the American Welding Society at no additional cost. The lecture on metallurgy to be given on Oct. 19th will be delivered by Dr. Nelson. All other lectures will be by Prof. McKibben. The titles of the lectures, with dates, are as follows:

Oct. 5th: Fundamentals and Processes of Welding and Gas Cutting, and Their Range of Applicability.

Oct. 19th: Metallurgy of Welds.

Nov. 2nd: (a) Design of Welded Joints; Stresses, Shrinkage and Distortion; Fillet Welds; V and U Butt Welds; Seat Angles. (b) Design of Machinery for Welding.

Nov. 16th: Welding of Bridges and Buildings; New Structures; Strengthening Existing Structures.

Dec. 7th: Pipe and Pressure-Vessel Welding, Inspection; Testing by Destructive and Non-Destructive Methods; Training and Qualifying Welding Operators; Welding Wire.

Dec. 17th: Recent Applications of Welding to the Boulder Dam Penstocks, to the Century of Progress Exposition, and to Ships.

School Offers Display Space to Manufacturers

Several manufacturers have taken advantage of the offer of the Cleveland School of Welding to display their equipment in the school for the benefit of the students. The school has installed in its general office two tables, each having three display booths, 31 in. wide by 18½ in. deep by 20 in. high. Each booth is totally enclosed, with only the front open, and is provided with an electric light in the top.

These booths are offered, rent free, to manufacturers of welding equipment or welding wire. Most of them are now spoken for, and three manufacturers have already installed their displays.

International Acetylene Assn. to Meet in Pittsburgh

For the first time in the 37 years of existence of the International Acetylene Association, its annual meeting this year will be held in Pittsburgh, Pa. The date is Nov. 14th, 15th and 16th, and all sessions will be at the William Penn Hotel.

The steel industry being the outstanding user of the oxyacetylene process of welding and cutting metals, it was but natural that consideration be given to the holding of the Association's annual convention in the center of the great western Pennsylvania steel-producing area. The program will include papers and discussions of vital interest to manufacturers and users of steel as well as of other types of ferrous and non-ferrous materials.

The Address of Welcome will be delivered by Former Governor John P. Fisher of Pennsylvania, well-known figure in the industrial as well as the political life of the state. The opening session will also be addressed by Dr. George T. Baker, president of Carnegie Institute of Technology, who is a leader in engineering thought and an outstanding figure in engineering education. The annual report of the Oxyacetylene Committee will also be presented at this session.

The afternoon session on Wednesday, Nov. 14th, will be devoted to oxyacetylene cutting with particular reference to the newer developments in steel-mill applications. The Chairman of this session will be Mr. W. D. Miller, of the Bethlehem Steel Co., Johnstown, Pa., and the speakers will include such eminent authorities as Mr. Hampton, of the National Tube Co., and Mr. Firth, of the Firth-Sterling Steel Co.

Dean E. A. Holbrook, of the Engineering School of the University of Pittsburgh, will preside at the Thursday morning session, the subject of which will be "Metallurgical Aspects of the Oxyacetylene Process." Speakers at this session will include C. W. Obert, Union Carbide and Carbon Research Laboratories, Inc., and honorary secretary of the Boiler Code Committee of the American Society of Mechanical Engineers, and Prof. J. H. Zimmerman, Massachusetts Institute of Technology.

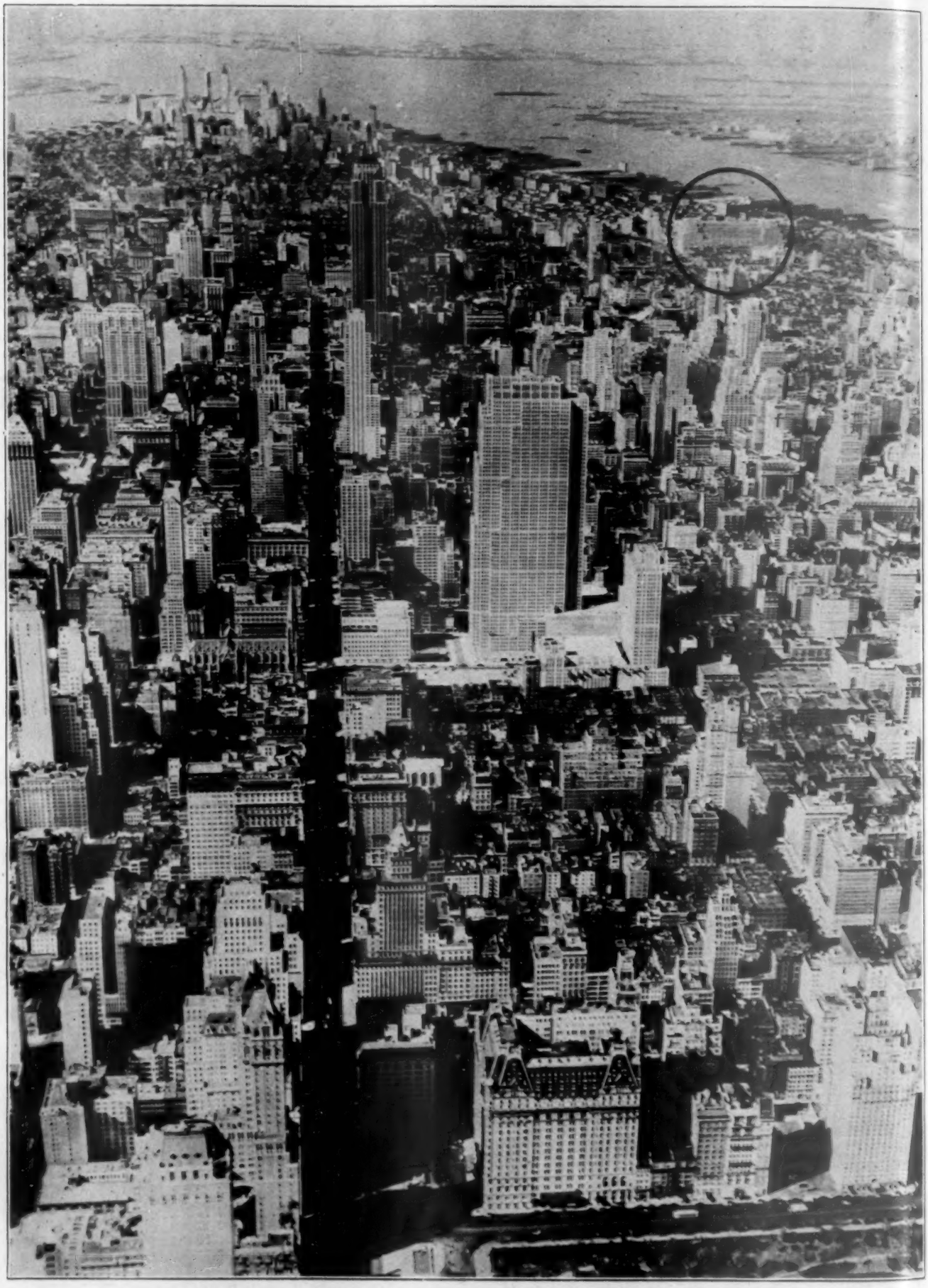
On Thursday afternoon, the session will be devoted to pipe welding and testing. The Chairman will be Dr. F. M. Speller, chief metallurgist, National Tube Co. Speakers will include G. O. Carter, The Linde Air Products Co.; John J. Crowe, Air Reduction Co., Inc.; James W. Owens, Pittsburgh Testing Laboratories; and John Zink, chairman of the Welding Committee of the Heating, Piping and Air Conditioning Contractors National Association.

On Friday morning there will be a session on transportation, the chairman of which will be E. W Smith, vice-president of the Pennsylvania Railroad. There will be papers on the construction of transportation vehicles by welding, the maintenance of railroad rolling stock and the oxyacetylene process in railroad maintenance-of-way work. One of the speakers at this session will be J. R. Watt, maintenance-of-way engineer, Louisville & Nashville Railroad Co.

In view of the vast importance of the related subjects of education and safety in welding, a session on Friday afternoon will be devoted to this subject. The Chairman will be Dean R. L. Sackett, head of the School of Engineering, Pennsylvania State College, and among the speakers will be E. F. Blank, Jones & Laughlin Steel Co., and chairman of the Metal Section of the National Safety Council; and W. K. Estep, chief engineer of the Middle Department Rating Association, Pittsburgh, Pa.

Because of the extremely urgent insistence of the Association's members in the Pittsburgh area, the Program Committee of the Association is additionally considering the possibility of presenting in Pittsburgh, "The Prosperity Process," the 4-act industrial drama which the Association has presented to enthusiastic audiences in Philadelphia, Chicago and Detroit.

Any individual who is interested in metal-working processes is invited to attend these meetings and participate in the discussions. The Association makes no charge for registration.



New York City, Looking Downtown From 59th St. to the Battery.

The Port of Authority Building is shown in the circle. In the right center is the 70-story RCA building of Rockefeller Center, with the Empire State Building towering to the south.

The Hotel New Yorker Will Be Headquarters of the American Welding Society

Alternating-current welding, fatigue tests, qualifying welding operators, spot welding of duralumin, and other timely topics are on the

Program of the Fall Meeting, American Welding Society

TECHNICAL sessions and committee meetings will be held in the Hotel New Yorker. Upon registering, each visitor and member will receive a copy of the papers to be presented at the technical sessions, and also a badge admitting him to the Exposition and to the inspection trips and social events.

Registration facilities will be provided throughout the week from 9:30 a. m. to 5:00 p. m., in the Hotel New Yorker.

For the ladies, arrangements have been made for a luncheon, a visit to the NBC broadcasting studios, an inspection tour of the liner *Aquitania*, and a boat trip around New York harbor.

Monday, October 1st

1:45 p. m. Opening Session. Introduction of President of the American Welding Society, by S. S. Scott, chairman of the New York Session. Address of Welcome by President D. S. Jacobus.

2:00 p. m. Presentation of Miller Memorial Medal Award.

2:30 p. m. Technical Session. D. S. Jacobus, president, presiding.

A popular lecture on "Steel in Residence Construction," by F. T. Llewellyn, U. S. Steel Corp.

"Use of Polarized Light as Applied to Welding Products," by E. W. P. Smith, The Lincoln Electric Co.

"Impact Resistance of Welded Joints," by W. Spraragen, secretary of the American Bureau of Welding.

6:30 p. m. Dinner meeting, Board of Directors, Hotel New Yorker.

Tuesday, October 2nd

9:45 a. m. Technical Session. Leon S. Moisseiff, chairman of the Structural Steel Welding Committee, presiding.

"An Examination of Welds Made Under Field Conditions for High-Pressure, High-Temperature Steam Station Piping," by D. H. Corey, engineer, Detroit Edison Co., and A. E. White, director, and C. L. Clark, University of Michigan.

"Investigation of Welded Seat-Angle Connections," by Inge Lyse and N. G. Schreiner, Fritz Engineering Laboratory, Lehigh University.

"Photo-Elastic Studies of Seat-Angle Problems," by Inge Lyse and Douglas M. Stewart, Fritz Engineering Laboratory, Lehigh University.

"Welding in Engineering Education," by J. H. Zimmerman, Massachusetts Institute of Technology.

2:00 p. m. Technical Session—Fundamental Research in Welding. C. A. Adams, director of American Bureau of Welding, presiding.

"Effect of Peening on Physical Properties of Welds and Stress Relief," by O. M. Harrelson, Georgia School of Technology.

"Notes on the Fatigue Testing of Welds," by J. H. Zimmerman, Massachusetts Institute of Technology.

"Some Tests of Thermit Welds," by Percy Hodge, Stevens Institute of Technology.

"Residual Welding Stresses," by R. E. Jamieson, McGill University.

"Corrosion Fatigue of Welded 18:8 Stainless Steels," by Wilber E. Harvey, A. J. Ciastkewicz and F. J. Whitney, Lehigh University.

"Resistance Welding of Duralumin," by N. F. Ward, University of California.

7:30 p. m. Conference and Meeting of Fundamental Research Committee, American Bureau of Welding, H. M. Hobart, committee chairman, presiding. Hotel New Yorker. This conference is scheduled for the benefit of university research workers in the fundamentals of welding.

Wednesday, October 3rd

9:45 a. m. Technical Session. J. J. Crowe, senior vice-president, presiding.

"Brazing With Silver Solders," by R. H. Leach, Handy & Harman.

"Sprayed Molten Metal Coatings," by E. V. David, Air Reduction Sales Co.

"Hard-Facing," by B. E. Field, Chief Metallurgical Engineer, Haynes Stellite Co.

"Flame Machining," by H. H. Moss, Development Section, Engineering Department, The Linde Air Products Co.

2:00 p. m. Railroad Session. J. B. Tinnon, chairman of the Meetings and Papers Committee, presiding.

"Track Maintenance," by I. H. Schram, Engineer, Maintenance of Way, Erie Railroad.

"Welded Rail Joints—Main Track—Steam Railroads," by H. S. Clarke, Engineer, Maintenance of Way, Delaware & Hudson Railroad.

"Technical Phases of Application of Welding in Hi-Tensile Division of E. G. Budd Manufacturing Co.," by M. B. Butler.

Thursday, October 4th

9:45 a. m. Technical Session. E. A. Doyle, past president, presiding.

"A Study of Alternating-Current Arc-Welding-Circuit Characteristics," by A. M. Candy, Westinghouse Electric & Manufacturing Co.

"Automatic A. C. Arc Welding Class 1 Pressure Vessels," by O. A. Tilton, General Electric Co.

"Impact Resistance of Some Steels and Welds at Sub-Zero Temperatures," by R. K. Hopkins, M. W. Kellogg Co.

"The Acceptance of Alternating-Current Arc Welding," by C. J. Holslag, Electric Arc Cutting & Welding Co.

2:00 p. m. Symposium on Qualifying Operators of Welding Equipment and Expenses Incurred Therein. F. T. Llewellyn, past president, presiding.

"A Discussion of the Methods for Qualifying Operators of Welding Equipment under A. S. M. E. Boiler and Pressure-Vessel Codes," by W. D. Halsey, Hartford Steam Boiler Inspection & Insurance Co., and Alexander Kidd, M. W. Kellogg Co.

"Qualifying Operators of Welding Equipment," by E. D. Debes, Bethlehem Shipbuilding Co., Fore River Plant, and "Qualification of Welding-Equipment Operators," by H. W. Pierce, New York Shipbuilding Co.

"Structural Welding," by G. D. Fish, Westinghouse Electric & Manufacturing Co.

"Pipe Welding," by Dr. S. Lewis Land and John H. Zink, Heating, Piping and Air Conditioning Contractors National Association.

"Testing of Welders," by J. W. Owens, director, National Weld Testing Bureau.

7:00 p. m. Annual Banquet—Stag Affair, Hotel New Yorker.

Friday and Saturday, October 5th and 6th

Inspection Trips — Includes Midtown Tunnel, a brewery and a plant featuring welding and cutting operations.

Get "*H. O. T.*" on Welding

■ By H. O. T. RIDLON

[This section is dedicated to Better Welding and Better Welding Shops. Suggestions and criticisms are invited.]

Learning a Lesson From Goldsmith Cellini

Perhaps we should not hash, hash and re-hash such horrible things as the disaster of the *S. S. Morro Castle*, but it seems to me that there is a great lesson in it for all of us who build things. Those automatic bulkheads weren't automatic; at least they didn't work. Let us try when we build the things we do, to do them so well that we shall not have such a shadow with us as those who built those bulkheads will always have. Let us all try to be master craftsmen like that great worker of metals in Old Italy, Cellini, the goldsmith. You've seen the movie, "The Affairs of Cellini," the dashing, audacious, daring craftsman in days when the arm was strong and the steel sharp. Yes sir, I'd bet if that guy lived today he'd be a welder.

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This Is Particularly for the Gas Welder

The head man at one of the oldest and largest welding schools the other day shot a fast one at me, it being "Hot, don't you think that acetylene welders should know more about welding?" Now he didn't mean the three R's or some other things I might tell you about (but won't, not because I can't, but I hardly think this is the time or place). What this big shot meant was that the average acetylene welder was satisfied with what he knows. To me that was very interesting, for in spite of all that has been written in trade papers, the expense manufacturers of oxyacetylene equipment, welding rods and accessories have gone to in experimenting and publishing their finds in circular "ads," indicates that this must be true. Manufacturers have also gone to no end of expense in putting on welding clinics that are free to anyone who seeks welding knowledge. They may come, learn and profit thereby.

A short time before that I was talking with another gentie, a smart guy this, who really knows on which side his bread is buttered. He was telling me a most astounding fact—that if he went into a plant and told the welding foreman that he wanted to interview his welders to sell them a subscription to his welding magazine and they employed 100 oxyacetylene welders and 25 metallic-arc welders, and the foreman said he could interview either group but not both, he would pick the arc welders, because, he said, they were by far the most progressive, more anxious to learn the new things that were happening in their industry, and he would sell more subscriptions to the 25 arc welders than he would to 100 oxyacetylene welders. Now, that really is something to me, and you torch hounds think it over and take stock of yourselves. There is plenty to learn for those that want it—it's all FREE, and YOU profit.

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Don't Miss That Big New York Show!

And speaking of education, now is the starting of a number of very fine welding clinics around this great country of ours. The daddy of them all is, of course, the National Metal Exposition and National Metal Congress, which is to be held in conjunction with the American Welding Society and a number of other Societies whose interest is in metals and their fabrication and treatment. This swell show will be held in New York City, October 1st to 5th inclusive. Believe you me, Mister, don't miss that show if you can help it. I'm hoping that my boss will let the Old Maestro be on deck, for I sure don't like to miss 'em. But there's work to be done and I may have to pass it up. Anyway I'm hoping that I'll be seeing you there!

• • •

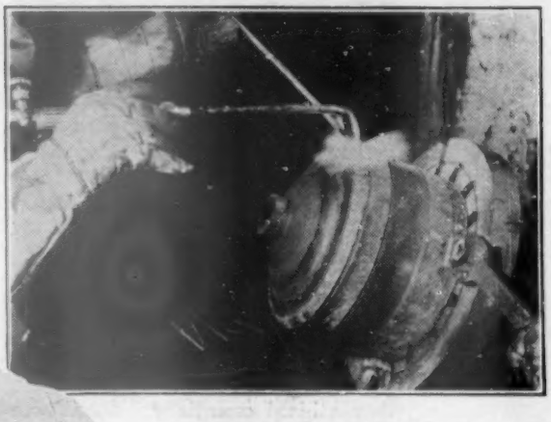
The thought for the month: Bet on the good old U.S.A. and you'll win. I've been traveling a lot lately and that's my bet, and always will be.

Welding Group to Be Guests of St. Louis Plant

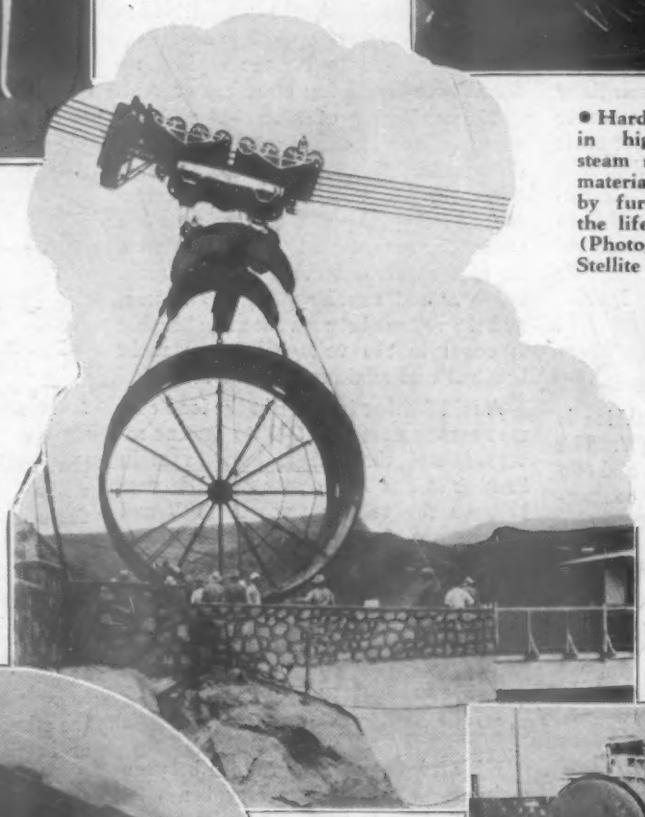
A visit to the plant of the Midwest Piping & Supply Co., at 1450 South 2nd St., St. Louis, Mo., will be made by the St. Louis Welding Society on Friday, Oct. 5th, at 8 p. m. The visitors will be shown the shops and testing laboratory, which will be in full production, as the office and shop men will remain on the job for the benefit of the Society visitors. At 8 p. m. sharp there will be held a short meeting of the members of the Society, at which time announcement will be made of the new officers elected for the ensuing year. Ballots have been sent to the membership. This, the first meeting of the season, is open to all—non-members and members alike.

WELDING NEWS ▪ ▪ ▪ IN PICTURES

● Welded like a modern all-steel automobile body, this kitchen range has sufficient strength to hold seven men. No bolts or screw heads are in evidence, and no sagging or wobbling can occur. (Photograph courtesy of Westinghouse Electric & Manufacturing Co.)

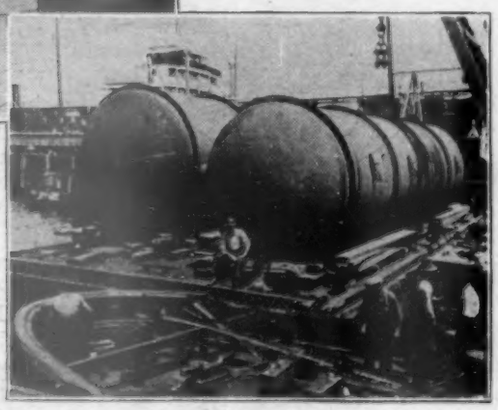


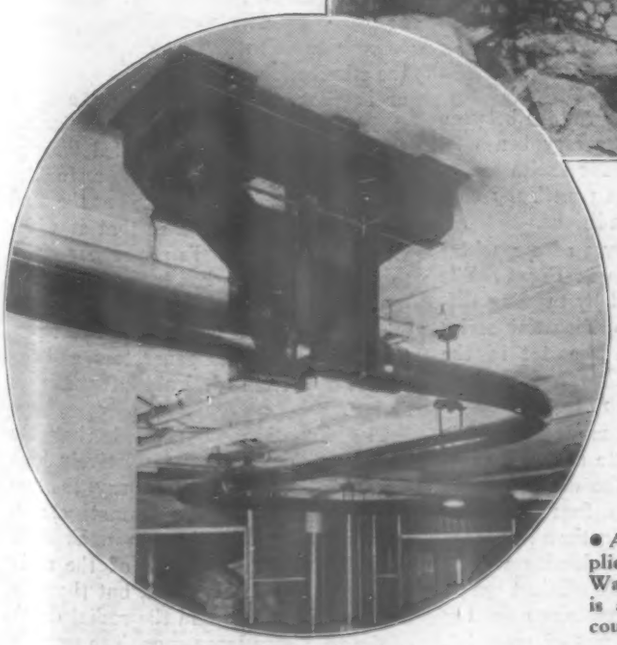
● Hard-facing a 9-in. valve disc, used in high-temperature, high-pressure steam service. Two layers of hard material are applied, each followed by furnace heating. This increases the life of the disc six to ten times. (Photograph courtesy of Haynes Stellite Co.)



● A 30-ft.-diameter welded pipe section ready to be lowered into the canyon at Boulder Dam. (Photograph courtesy of The Babcock & Wilcox Co.)

● New York City's new seaplane ramp, from which commuters will take planes for Long Island points, is supported by four arc-welded pontoons, two of which are shown here. Each tank is 46 ft. long and divided into four watertight compartments. (Photograph courtesy of Hobart Brothers.)





● An underground arc-welded steam line supplies this 6-in. welded main in the Federal Warehouse, Washington, D. C. The hanger is also of welded construction. (Photograph courtesy of The Lincoln Electric Co.)

Evolution of Welding-Generator Design—II

Second of a Series of Three Articles

■ By K. L. HANSEN
Consulting Engineer, Harnischfeger Corp.

IT WAS but natural that early in the history of development of the arc-welding generator, efforts were made to eliminate the separate exciter. The exciter windings and commutator are small and delicate compared with those of the welding generator and proved to be a source of considerable trouble. Furthermore, the exciter takes up room where utmost compactness is desirable and, of course, adds to the cost. If the exciter could be eliminated without impairing the performance or introducing other undue complications, the desirability of doing so could not be questioned.

Some time during the years 1918 and 1919 two makes of self-excited arc-welding generators appeared. While not exactly identical, they utilized essentially the same scheme for obtaining a source of constant excitation without a separate exciter. This scheme was described in a paper by S. R. Bergman and H. L. Unland, presented at the 36th Annual Convention of the American Institute of Electrical Engineers, White Sulphur Springs, W. Va., June 29 to July 2, 1920.

One Method for Obtaining Self-Excitation

The Bergman and Unland machine is shown diagrammatically in Fig 7. The armature is wound for two poles and two sets of main brushes bear on the commutator at *A* and *D*. A third or auxiliary exciting brush, bears on the commutator at *B*, approximately half way between the main brushes.

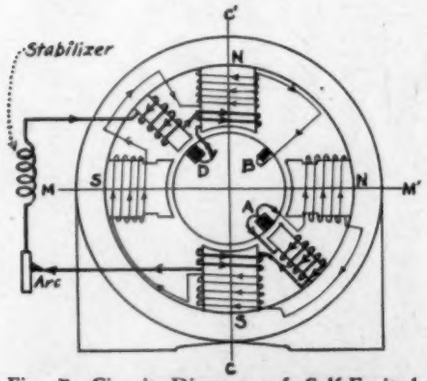


Fig. 7. Circuit Diagram of Self-Excited Welding Generator With External Stabilizer.

The field structure has four poles and two commutating poles. On open circuit, the poles marked *N* are of the same polarity and so are the poles marked *S*, giving in effect a two-pole magnetic field. These conditions change with increasing load on the machine.

The magnetic field is made up of two components at right angles to each other, the main field with its axis along the line *M-M'* and the cross field with its axis alng *C-C'*.

The magnetic field set up by the current flowing in the armature conductors has its axis in the interpolar space where the commutating poles are placed. This field may be resolved into two components: one along the axis of field *M-M'* and strengthening it, the other along the axis of *C-C'* and weakening it. The magnetic circuit *M-M'* is saturated so that the increased magnetization from the armature can increase the flux but slightly. On the other hand, the magnetization from the armature opposing field *C-C'* causes the field to become rapidly reduced with increasing armature current.

The weakening of field *C-C'* with increasing load is further enhanced by a differential series field placed on its poles. When the demagnetization of the armature and the series field reaches a certain point, the cross field is reduced to zero. In that case the voltage between main brush *D* and auxiliary brush *B* is zero, and the voltage between the main brushes is equal to the voltage between main brush *A* and auxiliary brush *B*.

A still further increase in the load current causes cross field *C-C'* to become reversed, and the voltage between main brushes *A* and *D* becomes the difference between the voltage from *A* to *B* and the voltage from *B* to *D*. On short-circuit, these voltages become substantially equal and their difference is zero, which is the voltage across the main brushes on short-circuit.

Voltage Across Shunt-Coils Is Practically Constant

With this scheme, the voltage between main brush *A* and auxiliary brush *B*, which voltage is used for excitation of the shunt coils, remains practically constant under all load conditions.

The volt-ampere curves of a machine of this type are shown in Fig. 8. The six curves are obtained by tapping different points on the differential series field. By means of a rheostat in the shunt-field circuit, the voltage may be adjusted over a certain range.

A later development made it possible to eliminate the separate exciter and at the same time retain the design of the four-pole armature in a four-pole symmetrical field, which offers the advantages of a low brush current density with a short commutator and the efficient use of the space around the armature, resulting in a more economical use of material.

Before further describing and commenting on this scheme of design, consideration will be given to the early attempts to eliminate the stabilizer.

Eliminating the Stabilizer

The stabilizer is the heaviest, bulkiest, most expensive and most energy consuming of all auxiliary devices used in connection with an individual-operator welding generator. Many efforts have been made to eliminate this "excess baggage" by proportioning the generator so

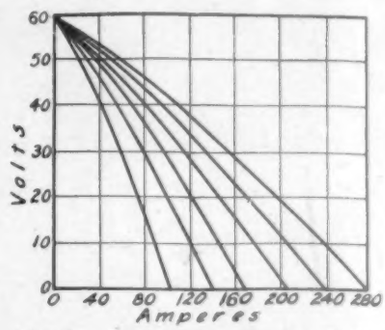


Fig. 8. Volt-Ampere Curves of the Machine Illustrated in Fig. 7.
(The six curves are obtained by tapping different points on the differential series field.)

that sufficient stability will be obtained without it or by incorporating special features in the design which will accomplish the same thing.

Some years ago I made an investigation with the object of producing a design in which the factors affecting momentary current fluctuations and, therefore, arc stability would be accentuated to such an extent as to point the way for the elimination of the stabilizer in whole or in part. The mathematical analysis which formed a part of this investigation was given in a paper entitled "Design of Constant-Current Generators for Arc Welding," which I presented at the same A. I. E. E. convention as that at which Bergman and Unland's paper was given, to which reference has been made. This paper included formulas for predetermining mathematically the transient performance of welding generators, and emphasized certain desirable features in design.

The investigation showed that the armature should have a relatively high number of turns, or, as we say, the machine should have a strong armature, and, as a necessary corollary, a weak field. The circumferential width of the main pole body should be small, but the pole arc should be wide and the radial depth of the pole horn large enough to provide

a good path for the flux resulting from cross-magnetization.

If a series field is used, the mutual induction between it and the shunt field should be as small as possible. It was suggested that this could be accomplished by having the separately excited field coils wound for the same polarity and placed on two diametrically opposite poles, the series field being placed on the other two poles.

It was also pointed out that momentary fluctuations of the currents in the arc circuit could be minimized by inserting a resistance in series with the separately excited field and applying a correspondingly higher excitation voltage.

The features of design mentioned are factors which contribute to the stabilization of the arc, but a careful theoretical analysis and practical observations made it apparent that a machine in which these features were made so predominating as to render the external stabilizer unnecessary would be commercially uneconomical. In addition to the proportioning of the machine as far as practicable to become self-stabilizing, some special design feature had to be introduced.

Means for Increasing the Internal Reactance

Obviously this special feature must be of such nature as greatly to increase the internal reactance of the machine. It occurred to me that the commutating coils would lend themselves readily to a novel arrangement which would accomplish this. By extending some of the

Fig. 9. Field Ring of Arc Welder Having Internal Stabilizing Windings.

turns of the commutating coils to the adjacent main-pole flanges, and completely surrounding the extended turns with laminations, we obtain a large leakage flux interlinking with the commutating field. This leakage flux serves greatly to augment the reactance and at the same time does not interfere with the normal function of the commutating field to set up the required flux in the commutating zone. The commutating winding is thus made to serve a double purpose: It acts as a commutating field, and it increases the internal reactance, thereby helping to stabilize the arc.

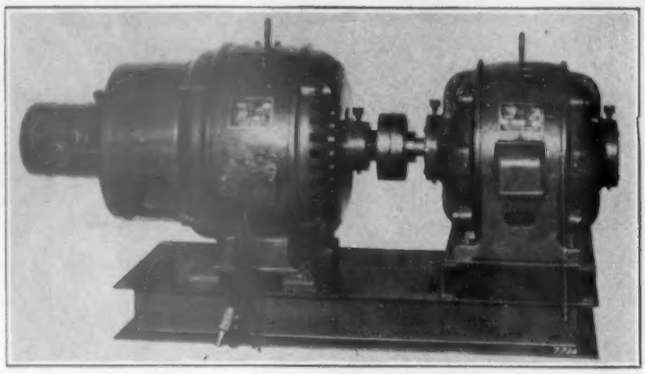


Fig. 10. Welding Unit Employing Winding Shown in Fig. 9 and External Exciter.

Fig. 9 shows a field ring with this arrangement of the commutating winding. A later development was the placing of all the commutating winding, instead of just part of it, in the pole flanges, which has the advantage of simplicity over the one shown in the illustration, since there are no coils on the commutating poles, and it is also more effective in producing stability.

A little consideration will show how effectively the material is utilized with this arrangement. Besides the dual role played by the commutating winding, the main poles also function in a dual capacity: they act as carriers of the main flux, which is responsible for the terminal voltage, and they also furnish the magnetic circuit for the stabilizing winding.

Now, the main flux happens to be greatest on open-circuit, when the terminal voltage is highest. At that instant there is no need for a magnetic circuit for the stabilizing winding as there is no current flowing in it and, therefore, no flux set up by it. As the current in the stabilizing winding increases, both the terminal voltage and the main flux decrease. That is, as the need for a magnetic circuit to support the flux of the stabilizing winding increases, the demand for a magnetic circuit to support the main flux decreases, and vice versa. That makes possible maximum utilization of the main poles.

Current Adjustment Through Brush-Shifting

Fig. 10 is an illustration of the complete set using the winding illustrated in Fig. 9. It will be noticed that an external exciter was used. Current adjustment was obtained by means of a rheostat in the separately excited field, which scheme was rather unsatisfactory, especially on lower currents when the open-circuit voltage would be too low. To overcome this difficulty, a brush shifter was added. When the brushes of a d.c. generator are shifted forward from neutral, the armature current has a demagnetizing component acting very similar to a bucking or differential series field.

With a brush shifter, the demagnetization can be varied in as many and as fine steps as desired. A rheostat in the separately excited field, in combination with a brush shifter, therefore, constitutes a really independent voltage and current control, or dual control, which is not the case when the current can be varied independently of the voltage in three or four steps only. This true dual control did not, as a general proposition, work out successfully, for the simple reason that the operator seldom, if ever, set the machine so as to obtain the most desirable combination of open-circuit voltage and welding current.

Self-Excited Generator With Normal Four-Pole Field

A careful consideration of the phenomena involved in the early self-excited generator led to the development of a scheme of self-excitation in which it is not necessary to employ a two-pole armature in a four-pole field structure. As this later scheme employs a normal four-pole armature in a normal four-pole symmetrical field, the main current is carried on four brush studs instead of two, as in the scheme previously described, and it is, therefore, much easier to keep the brush current density down to desirable low values without having to use excessively long commutators.

In order to obtain a desirable volt-ampere characteristic—that is, a characteristic in which the short-circuit current is appreciably greater than the welding current—it is necessary that the field be excited up to a certain value, even on short-circuit, when the regular self-excited field is reduced to zero. To obtain such excitation, use is made of the magnetic field set up by the armature current itself.

The magnetic field set up by the current in a direct-current armature can be resolved into two components.

If the brushes are shifted ahead of the neutral point—that is, shifted from the neutral point in the direction of rotation—these components will consist of a cross-magnetizing component and a demagnetizing component.

The cross-magnetizing component has

its axis displaced 90 electrical degrees from the axis of the field pole, and thus will neither magnetize nor demagnetize the field pole, except through an incidental saturation effect, which it is not necessary to consider here. It does, however, distort the main field, and that is of great importance in what will be considered hereafter. The demagnetizing component of armature current has its axis in line with the field pole and tends to weaken the magnetic field set up by the field coil.

If the brushes are moved backward—that is, against the direction of rotation, from the neutral point—the cross-magnetizing field of the armature remains substantially the same, but the demagnetizing component of the armature will be changed into a magnetizing component.

With the brushes operating on the electrical neutral, there will be neither a direct demagnetizing nor a magnetizing component of armature magnetomotive-force.

It is the cross-magnetizing component which is utilized to furnish the necessary excitation as the load increases and as the excitation obtainable from the main brushes decreases. As already stated, the cross-magnetizing component of armature current tends to distort the main field. The distortion is such that there is an increasing magnetic density in the air gap from the center line of the pole in the direction of rotation, whereas there is a decreasing magnetic density with increasing distance from the center line of the pole against the direction of rotation. Because of this distortion of the magnetic field, it is possible to have a considerable field included between two sets of brushes displaced from the main brushes, even though the field included between the main brushes is reduced almost to zero. This condition can best be illustrated diagramatically, as in Fig. 11.

Auxiliary Brushes Used for Excitation

In addition to the main brushes the machine is equipped with two sets of auxiliary brushes, spaced from 50 to 60 electrical degrees ahead (with the direction of rotation) of the main brushes. Line *A* in Fig. 11 represents the no-load field form. It will be seen that the auxiliary brushes take in part of the negative portion of the field form. The voltage across the auxiliary brushes on open-circuit is therefore proportional to the rectangle *BCDE*.

What will be the condition on some load—for example, on short-circuit? Assume that saturation is negligible on short-circuit so that fluxes are proportional to m.m.f.s (magnetomotive-forces). The voltage on the shunt coil excited from the main brushes falls to zero on short-circuit and the m.m.f. of the field is reduced to line *F*. In addition, there is a direct demagnetizing force from the armature which reduces the m.m.f. on the field still further to line *H*. The remaining m.m.f.s are those due to the armature cross-magnetization and the stabilizing winding.

The distribution of flux in the air gap under the main poles is not directly affected by the m.m.f. of the stabilizing winding, but is indirectly affected by this m.m.f. when the pole shoe becomes saturated; neglecting that for the moment, the flux distribution is the resultant of the net m.m.f. of the field and the m.m.f. of armature cross-magnetization. This is shown in Fig. 11 as a broken line. The area included between this line and the base line, and lying above the base line, represents positive flux and, similarly, the area below the base line represents negative flux.

It will be noticed that on short-circuit there is still a considerable positive flux between the auxiliary brushes, whereas the net positive flux between the main brushes has been considerably reduced. The voltage thus maintained on the auxiliary brushes can be used for excitation, even on short-circuit. The auxiliary brushes are connected to a separate field winding, designated as the auxiliary field.

Fig. 12 shows a set of volt-ampere curves of a 300-ampere welder, and also the voltage of the auxiliary brushes for different loads and for different settings of the brushes.

When the main and auxiliary brushes are shifted forward simultaneously, two phenomena become pronounced: The armature demagnetization is increased, and the voltage on the auxiliary brushes is decreased, both of which tend to reduce the current. A wide variation in current can be obtained with a relatively small shift of the brushes. The brushes can be shifted by means of a micrometer screw arrangement, making possible minute gradations of welding current.

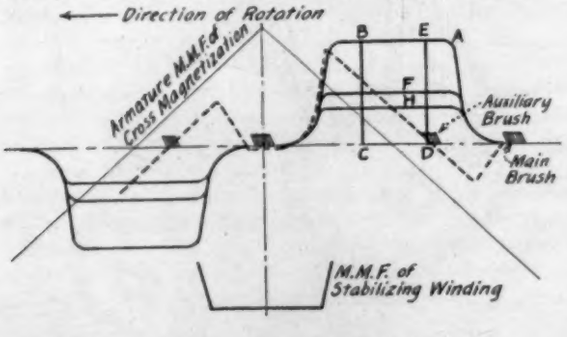


Fig. 11. Diagram of Field Strengths and M.M.F.s in Self-Excited Welding Generator.

The magnetic saturation in the main-pole shoe is an important factor in obtaining voltage regulation on the auxiliary brushes. With the ordinary pole construction, which does not lend itself readily to adoption of this scheme of excitation, the tendency is for the voltage on the auxiliary brushes to rise too rapidly with the first increase in load, and then to fall off very rapidly; in other words, to give a marked hump in the

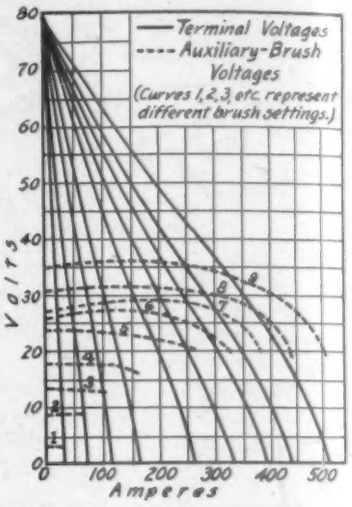


Fig. 12. Terminal Voltages and Auxiliary-Brush Voltages of 300-Ampere Welder Equipped With Auxiliary-Brush Shifter.

voltage curve of the auxiliary brushes. On the other hand, the pole construction designed to accommodate the stabilizing winding is admirably suited to this scheme of excitation because the saturation in the pole shoes can be controlled in such a manner as to give the desirable flux distribution in the air gap.

When the auxiliary brushes are caused to operate in the main field of the machine, commutation difficulties generally can be expected. In the design just described, the main poles are given a very marked bevel, so that the flux tapers off gradually toward the neutral zone, yet the auxiliary brushes do at times operate in the main field. Poor commutation, however, is precluded by a combination of several factors.

It has been stated that the necessary requisite in a good design of arc-welding generator is that the armature should have a relatively high number of turns—that means a high number of commutator bars. This greatly reduces the average volts per bar, as the terminal voltage of the machine is comparatively low. Furthermore, brushes of very high contact resistance are used as excitation brushes. Designed especially for high-voltage work, these brushes can handle up to 7 volts per bar. When used as excitation brushes on welding generators, they rarely have to handle in excess of 3½ volts per bar.

During the six and one-half years this system of excitation has been used, commutation trouble due to sparking under

the auxiliary brushes has been entirely negligible. Indeed, actual experience has shown that the commutator will polish just slightly better where the auxiliary brushes are bearing on it in addition to the main brushes.

Chemical-Tank Exposions Prove Fatal to Welders

Two fatal accidents to welders—one resulting from the welding of a sulphuric acid tank, and the other, an explosion of an ammonia tank during welding—are described in a recent issue of *Metals Safety*, issued by the National Safety Council, Chicago, Ill.

Concentrated sulphuric acid, when heated, acts very rapidly on iron and evolves hydrogen gas, which, mixed with air and heated to the proper temperature, will ignite, thus making the welding of sulphuric acid lines or tanks very dangerous. When necessary to repair any acid tanks, they should be removed to a remote location and thoroughly cleaned with water before any repair work is done on them, and then all work should be under the direct supervision of the master mechanic of the department, it is cautioned.

The case cited concerns a welder who was welding a nipple on the bottom of a sulphuric-acid measuring tank when an explosion occurred, which resulted in a fracture of his skull and burns from acid.

The ammonia-tank explosion occurred during the welding of a pinhole leak in a 500-gallon, 4x6-ft., welded steel concentrated-ammonia receiving tank, containing only one opening, which was a 2-in. measuring hole. The engineer and his assistant, both of long experience around the plant, had in the course of several years made about 30 oxyacetylene welds on this and other tanks used for the same purpose, without any trouble whatever.

Their regular procedure was to drain the tank of liquor, turn on a small amount of steam, but not enough to put pressure in the tank, then, after about 15 minutes, blow out the enclosed vapors. The assistant was standing at the end of the tank when the engineer started to weld. The head of the tank blew out with such force that the assistant was knocked 15 ft. away, inflicting injuries from which he died.

Examination of the exploded tank revealed a deposit of ammonia salt about 3 in. deep in the bottom of the tank. Though an opinion was offered to the effect that the light tar oils in the salt might have been the cause of the explosion, no satisfactory explanation of the accident has been made.

Trailer for Demonstrating Welding and Fuel Gases

For demonstrating welding and for featuring Philgas ranges and equipment at fairs and home-comings, the trailer illustrated has been built by the Winged Home Trailer Co., Inc., for Michigan Gases, Inc., Grand Rapids, Mich., dealers and wholesalers of welding equipment and fuel gases. Gas demonstrations will be given during the summer and fall, and in the winter the trailer will be used to feature welding equipment and processes.

The framework of the trailer is of welded steel construction. The name of the company, which appears on the sides, is done in wooden letters on which molten metal has been sprayed. The color scheme is a dark blue body and an aluminum top.

The trailer has a reproducer, radio and public address system. It weighs about 5,000 lb. when loaded, and is built with airflow lines. Two salesmen form the crew, and ample space is provided for living quarters for overnight trips.

Welded-Frame Trailer Used for Demonstrating Welding and Cooking Gases.

This Shop Preheats Castings With Kerosene-Burning Torches.

Uses Kerosene Torches for Preheating

By using kerosene torches for preheating castings for oxyacetylene welding, the St. Paul Welding & Manufacturing Co., 174 W. Kellogg Blvd., St. Paul, Minn., are able to prevent warpage and locked-up strains, and to insure machinable welds. They use "Torit" kerosene torches in their welding shop for this purpose. The expense of the kerosene or distillate is said to be only a trifle, and the welder busies himself with other productive work while the casting is heating. Much actual welding time is saved and the consumption of fuel gases is greatly decreased by welding after preheating instead of welding the work cold.

In the illustration, showing a view in the St. Paul shop, one of the "Torit" torches is preheating a section surrounded by firebrick. The other two torches are still in operation on another casting while the welding is being done, as in this case it was advisable to continue the preheating flame until the welding was finished. Upon completion of the welding, the sections are covered over with asbestos paper and allowed to cool very slowly.

No More Breaking of Cable at Terminals

"Here is an idea that has saved my welding shop a lot of grief," writes Fred T. Pindar, job-shop owner, of

Scheme for Ground-Plate Connection.

Valdosta, Ga. "Any arc welder knows how quickly the cable breaks off the terminal of the ground plate when throwing it around on all kinds of jobs. After trying springs and other methods of keeping the wire from breaking just outside the terminal, I hit upon this plan, which solves the problem for good. If every welder has had as much trouble as I have had, this plan will be worth passing on to them."

Applying Welding to the Construction and Repair of a Wide Variety of Plant Equipment

■ By R. J. COLLINS
Plant Engineer, Millers Falls Co.

THE building up of worn machine shafts, and the making of useful shop equipment such as storage shelves, portable cranes, jigs and fixtures, all by the use of arc welding, has helped to keep us from getting deep in the "red" during the trying times of the past three years.

We received our baptism in welding seven years ago when we bought a welding generator. Today, we are sold on welding, and realize that this arc welder was the best investment we ever made.

One of our first attempts at welding was a table made of a cast-iron slab with cold-rolled steel legs welded to it with monel, and every time we bounced something on the bench a leg would snap off. We soon made an angle-iron table, and later a larger one of still better design.

All our early welds were 100% welded —that is, we beaded and double-beaded everywhere a bead would fit in. All who brought in jobs to be welded were told to bring them back if they failed—and some did fail. We learned about welding from that, and from reading everything we could get our hands on, including advertisements.

Builds Up Motor Shafts at $1 Apiece

One of the earliest jobs we tackled was repairing the shafts of small motors of 1, 2 and 3 hp. These motors were used in individual-drive polishing wheels and were of the open type. The shafts would wear down considerably. Formerly we shrunk hardened sleeves on the shaft, then ground to size. That was satisfactory, but the average cost was over $8. Then I tried having new shafts installed, which cost an average of $6.50. By sending them back to the manufacturer for repair we reduced the cost to $3.50—a considerable saving over previous methods.

It was at this time that we bought our welding equipment, and we used this to build up these shafts. The procedure was to wash the rotor in naphtha, dry it, then set it up in a rotating chuck on the welding bench. Then we would weld a continuous bead around the shaft, starting at the shoulder of the oil-thrower and working around the shaft spirally toward the keyway, holding the current as low as possible and still obtain good fusion, and using a light-coated electrode to avoid the possibility of inclusions.

When completed, the rotor would be stood on end until cool, to avoid unequal cooling and to reduce warping. It was then set up in a lathe on centers and a rough cut taken to within $\frac{1}{16}$ in. of the final dimension. Then, if the shaft showed warpage, it was sprung to true in the lathe, and a finished cut made to within 0.01 or 0.015 in. of the finished size. It was then ground to size on a grinder.

In this manner we reduced the total cost of repair to an average of $1 and found that the repaired shaft wore longer than a new one—a condition presumably due to some characteristic of the weld metal which gives a tougher wearing surface.

> WHEN a machine part has to be repaired or a new piece of equipment made, welding is used for speed and economy. That's why, says Mr. Collins, "our arc welder was the best investment we ever made."

A $6 Repair Saves Buying a $48 Drive Shaft

An interesting repair of this type was on a 1¾-in. main drive shaft of a Cone automatic screw machine. This shaft was a hardened and ground piece of machine steel that developed a lateral fracture under the driving gear—about 2 in. long, 1¼ in. wide, and ¼ in. deep. To make a new shaft, or replace the old with a new one, would have been expensive, a new shaft costing about $48. In addition, there would have been a delay in getting the machine back into production.

So we decided to weld, by laying a series of lateral beads until the shaft was built to size. This was done slowly with as low a current as possible, each bead being peened. The shaft was then set up on centers and the amount of warpage determined. Then the entire weld was peened, and then turned to within $\frac{1}{16}$ in. of the finished size. The shaft was then checked for spring, and found to be about $\frac{1}{16}$ in. out of true at the weld, so a lateral bead was laid directly opposite the weld and the shaft again peened and checked. After three such trials, it was brought within 0.0005 in. of true and pronounced satisfactory. The cost was about $6 and the machine has since been in continuous operation for two years.

Five Portable Cranes Built by Welding

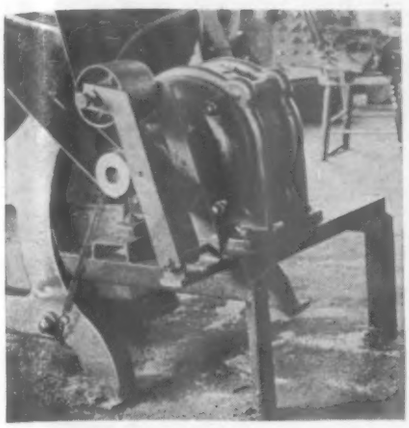
We have used welding successfully in the fabrication of portable cranes for different purposes about the plant, having made five of them in all. These cranes have a capacity of 1000 to 1500 lb. and are used mostly with loads of about 500 lb. or less. The total cost of material and labor averaged about $50 each, one of the latest ones costing only $35.

Another application is in racks and shelving. In one case we used 17½ tons of angle-iron in building a new finished-goods storage. This had a shelf area of 45,000 sq. ft. and was completely welded in three weeks by a welder and one helper.

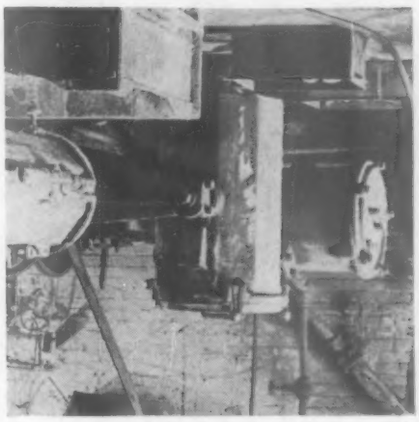
Another finished-storage job consisted of a series of shelves, 10 ft. high, 18 in. wide, 4 ft. long and 16 in. deep, all built by arc welding. Each 4-ft. shelf had stored on it 2 tons of hack-saw blades, and the entire space had a total storage capacity of about 50 tons.

In setting up a new department in the plant, it was necessary to use considerable 3- and 4-in. iron pipe on a gas-furnace job. All pipe was arc welded, and all bends were made by cutting at an angle and welding. On

Typical Applications of Arc-Welding in Plant of Millers Falls Co.

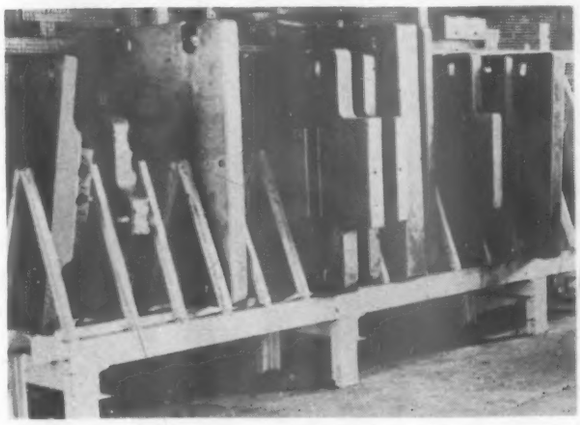


Motor support and idler for punch-press drive.

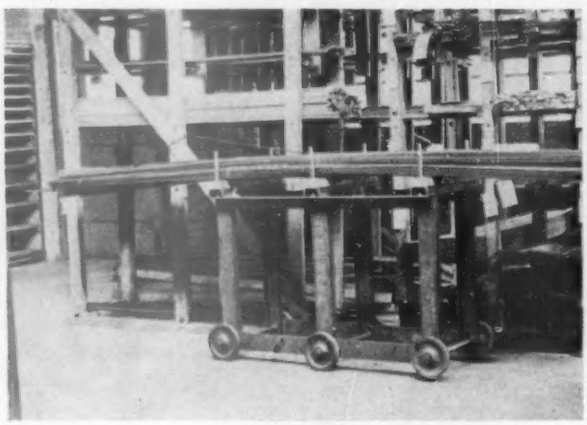


Tumbling barrel welded from ⅝-in. steel to replace cast-iron barrel that had failed with abrasive burnishing material. Welded barrel has given two years' service with every sign of giving ten years more. Cost $28 less than new cast-iron barrel.

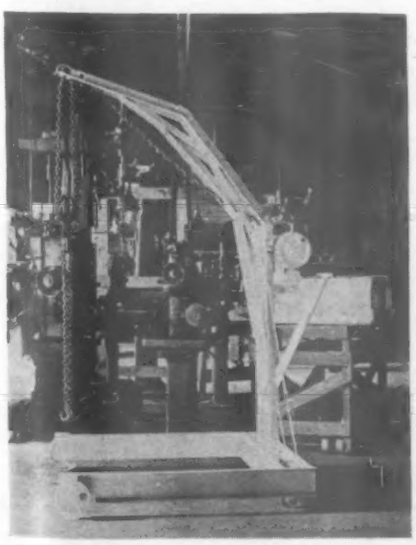
Cast-iron lug welded to cast-iron tumbling barrel when thread stripped.



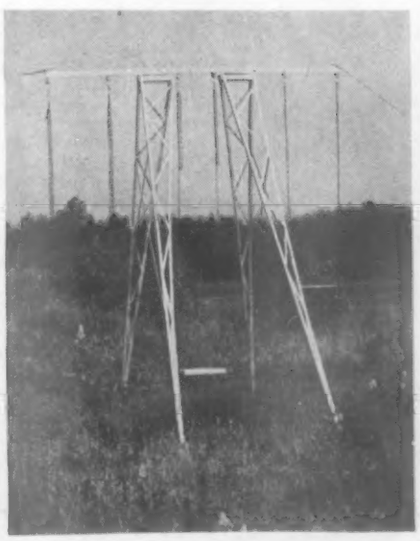
Punch-press-bedplate storage conserves space and, with mono-rail overhead, assists handling.



All-steel truck for handling steel stock. Height is correct for direct feeding presses.



All-steel portable crane, 1500-lb. capacity, 7 ft. 6 in. high, 48-in. span. Cost $35.



Children's combination swing trapeze and rings. Cost $10, including material and labor.

Angle frame for collector, ⅛-in. sheet-steel box, direct unloading into truck.

the same job a quenching-oil preheater was fabricated by arc welding.

Welded Jigs and Fixtures Have Many Advantages Over Castings

Jig and fixture welding is standard practice in our plant. This eliminates patterns, casting, and a lot of machining, giving a lighter, stronger and cheaper fixture with, above all, a minimum of delay from blueprint to use. Also, there is the possibility of welding changes and repairs to worn surfaces on the steel fixtures.

The forming tools of our wood-turning machines are made of band high-speed steel, formed and then welded to soft-steel shanks, at a reduction of 70% of labor costs over forging the tool steel formerly used. Furthermore, the life of the high-speed cutter is four times that of the old tool, and, owing to the fact that the forming tool is made of band stock of uniform thickness bent to the correct shape, the actual amount of grinding possible is increased three or four times.

Labor, materials and overhead are considered in computing our costs on welding. Since the average power used by the welder is less than 25% of the rating of the machine, the power item is of minor consequence and constitutes but a small fraction of the total cost of the job. In our case, the unit cost of power is so low that we do not figure power costs in welding at all.

Cleaning and Repairing Underground Pipelines

The corrosive soil conditions encountered along sections of an important California oil-pipeline system demand a long season each year of hard effort on the part of the pipeline-treating gangs. A section of the pipe line is dug up and cleaned, and badly pitted sections are cut out and replaced with new pipe, covered with asphaltic materials. The repaired section is then again covered with earth.

The oil pipelines are for the most part buried beneath a 2-ft. covering of earth so as not to interfere with agricultural pursuits and other activities. They are, however, exposed to the relentless, destructive influence of corrosion. In many localities the soil waters carry such quantities of alkali that pipe laid without a protective covering becomes a mass of pitted junk in the course of a very few years.

The maintenance of these pipe lines is, therefore, a large undertaking. During the summer months several big crews of men are constantly engaged in making repairs and applying asphaltic waterproofing to the pipe. Oil company engineers have learned throughout a quarter of a century's experience that a thick, well-reinforced coat of asphalt adds greatly to the life of buried pipelines.

Pipeline repair work involves five main steps: uncovering the pipe, cleaning it thoroughly, replacing badly pitted sections with new pipe, applying a thick protective covering of asphalt materials, and again covering the repaired section with a blanket of earth.

Where conditions permit, a ditching machine or other power equipment is used to uncover the pipe. A most ingenious derrick puts all the burden of lifting the pipeline onto a tractor and assures rapid and efficient operation.

Pipe that is to be removed is cut out by oxyacetylene torches, and replaced sections are welded into position. Repairing is also effected by welding.

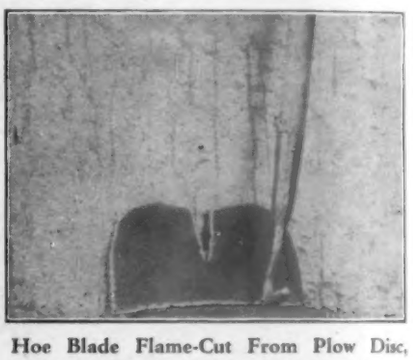
One large oil concern employs pneumatically operated machinery for cleaning the pipe preparatory to cutting out the corroded sections. A train consisting of portable air compressors and a trailer towed by a tractor follows along the pipeline and supplies compressed air for operating three special devices for cleaning the pipe. The first machine has 16 pneumatically operated hammers known as "tappers," which pound or tap the pipe, knocking off the rust and other accumulations. Following this machine is a man who operates a pneumatic hand chipping device for removing all accumulations that the first machine may have missed. Then follows a special pneumatically operated machine consisting of a series of revolving brushes, which complete the cleaning of the surface of the pipe. The pipe is then ready for the welding operations and for the application of the protecting covering of asphaltic materials.

Cleaning Pipe Preparatory to Making Repairs.

Welded Repair Makes Better Hoe Than New

A good idea for job-welding-shop owners in rural districts is passed to the readers of *The Welding Engineer* by T. E. Howard, manager of the La Habra (Calif.) Iron & Welding Works.

Mr. Howard advertises for old worn-out hoes and offers to salvage them by cutting out the worn blades and welding on new ones made from material taken from sections of old plow discs that have been discarded.



Hoe Blade Flame-Cut From Plow Disc, Ready for Welding to Hoe Handle.

With the cutting torch, a V-shaped cut is made next to the "gooseneck" of the old hoe blade. Then a disc section is heated and flattened from its dish shape, and marked by means of a pattern for the desired size of hoe. With the torch, the new hoe blade is then cut out, leaving a V-shaped slot at the top to fit that of the "gooseneck" section of the handle. With file and grinder, the two parts are smoothed up, after which they are welded together.

The tools made by this method are said to be of much better quality than the original hoes, inasmuch as the steel from the old disc is heat-treated and gives a longer life.

Each hoe is repaired for 75 cents, which, Mr. Howard states, nets his shop a fair profit, and also gives the farmer a new hoe which it is said will out-wear three ordinary new ones.

In some cases, these hoes are made in extra-large sizes, being designed and used extensively in that district for irrigating fields of vegetables.

Multiple-Operator Welding Sets *or* Single-Operator Sets ■ *which?*

■ By J. L. JONES

Electrical Engineer, Bureau of Construction and Repair, Navy Department

THE question, "Which shall I buy —constant-potential multiple-operator arc-welding sets or variable-voltage single-operator welding sets?" is one that is old but ever recurring. As this question appears to be under discussion frequently at the present, it is timely to cite some of the advantages and disadvantages of the two types of equipment.

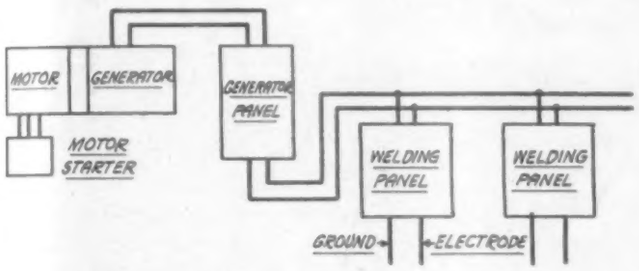


Diagram of Multiple-Operator Outfit.

It should be understood that the use of the term constant potential in connection with multiple-operator sets relates to the generator voltage and not to the arc voltage. Constant arc voltage is very desirable, but cannot be obtained with multiple-operator sets any more than with single-operator sets.

When considering this matter, the prime points usually at issue are: comparative cost, space occupied, weight, flexibility, and accessibility or availability. One point, however, which is more important than any or all of the foregoing is generally overlooked; that is, which type of generator has fewer inherent faults and will make it easier to obtain good uniform welds, or, in other words, uniformly reliable welds, and also permit test specimens to be readily produced under operating conditions.

Range of Ampere Ratings

Multiple-operator arc-welding motor-generators are available with ratings of 500, 750, 1000 and 1500 amperes. The larger sets, due to weight and size, are stationary outfits only. Single-operator sets are available with ratings of 100, 200, 300, 400 and 600 amperes. Larger single and multiple sets are used under special conditions. All sizes of the single-operator type are usually portable and mounted on wheeled bases, although stationary sets may be obtained when desired.

When a multiple-operator set is purchased, it is necessary to obtain also a motor starter, a generator panel, and a number of separate welding panels. Each welding panel consists of a resistor, reactor, switches for regulating the welding current, and terminals. The welding generator current is controlled and furnished to the welding circuits by means of the generator panel and the welding panels.

Additional Equipment Required With Welder

Single-operator sets are usually self-contained, and have a motor panel and generator panel with welding terminals, all mounted on the motor-generator. It is only necessary to connect the welding leads to the terminals on the generator panel.

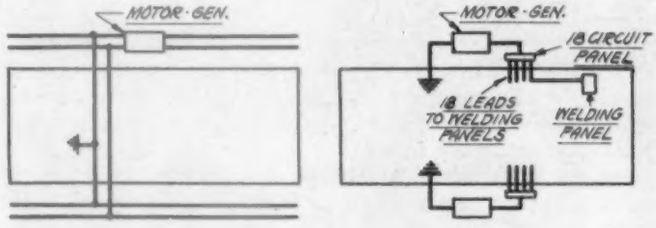
In the case of the single-operator sets, the motor panels are connected to the usual power feeders. On the other hand, for the multiple-operator sets, it is necessary to install special welding circuit feeders, with numerous outlets, from the generator to the various points of distribution, in addition to connecting the motor starter to the power feeders.

Having briefly outlined the general features, let us consider them somewhat in detail. First, the important point previously mentioned is one usually overlooked, which is, uniformly reliable welds and test specimens readily produced under operating conditions. As there is no means for satisfactorily and economically testing welds, except by methods which damage the welded material, it is imperative that equipment which will insure the best welds be used in order to eliminate as much uncertainty as to quality of the weld as possible.

Disturbances Set Up in Welding Circuit

Single-operator sets provide a separate welding circuit, which prevents disturbances from other welding circuits and reduces to the minimum possible interference with arc stability. Multiple-operator sets are subject to constantly varying disturbances which affect the arc. Manufacturers of multiple-operator sets recognize this fact and furnish flat-compound-wound generators to reduce interference. However, this does not prevent ever-changing welding voltage and current for each operator. These changes are beyond the control of the operators. Should several operators be welding with current from one generator, the welding line voltage for the operator nearest to the welding generator will be higher than that for the operator farthest removed, the amount depending upon the size of the welding line, length of the line, and the current.

When one or more operators cease welding, as is done at very frequent intervals, the voltage for the other operators immediately changes without a



Multiple-Operator Feeders.

warning to them, so that constant arc voltage is practically impossible. This results in unsteadiness of the arc, and welds not as uniformly satisfactory as those produced by a steady arc. Further, when some welders are using high current and about 30 volts at the arc while others are using less current with 16 to 18 volts at the arc, all of the arcs are not of equal steadiness and intensity.

Also, it has been found that the arc produced by a single-operator generator has better welding characteristics and greater snap or "pep."

The Problem of Making Comparable Weld Specimens

Another very important drawback to multiple-operator sets is that welders using them frequently are not checked as to the quality of welds they produce *under actual operating conditions;* as examples, when one operator only is welding, when two or more operators are welding, and also when one or more operators are welding and one up to the total number of operators are striking the arc, etc.

In order to test the ability of operators using multiple sets, sample welds should be made under operating conditions, such as with all operators welding, as well as with from one up to the total number of operators welding while others are striking arcs, etc. This would present a number of combinations, but should be required even though a large amount of testing would be involved. Tests made under other than all of the operating conditions are of but little value.

It is not the purpose of the article to convey the idea that welding may not be accomplished with either type of welding set. Ordinarily, however, one type is preferable. Let us consider other advantages and disadvantages.

If a ten or more operator set is used, ten or more operators would be unable to work should repairs or adjustments to the set be necessary. Trouble with a single-operator set would affect but one operator.

Moreover, with multiple-operator sets, bare and heavily coated electrodes could not be readily used simultaneously, due to reversed polarity being required for most types of coated electrodes. Single-operator sets would not be affected by this condition.

Comparison of Efficiencies

The efficiency of a welding set is determined by the welding load. Approximately the total number of operators must work constantly in order to obtain reasonable efficiency. A 1500-ampere set will have a motor of at least 135 hp. While this motor is idling, 12 hp. is being wasted.

A multiple-operator set is a constant-potential set and should develop at least 70 volts. As the voltage at the arc is 16 to 18 volts for bare electrodes and an average of about 30 volts for heavily coated electrodes, it is necessary to dissipate from 40 to 54 volts mostly by means of a resistor. It is found that 60% to 77% of the output of the set is wasted from this cause alone. The total input wattage, however, must be paid for by the consumer.

Another example of the difference in power required to drive the two types of sets is as follows: A 1500-ampere multiple-operator set is driven by a 135-hp. motor. A 200-ampere single-operator set is driven by a 10-hp. motor. Thus, for 1500 amperes generated by single-operator sets, 75 hp. would be required by the driving motors. This is 55% of the power required to drive a multiple-operator set of equivalent output.

Single-operator sets may be obtained portable so that they may be moved about the plant or from one plant to another. They may be used in one building for a while and then taken to another location. As previously stated, multiple-operator sets (except in the small sizes) are stationary sets and cannot be moved.

Multiple-operator sets must be secured in position, and in some cases structural supports and foundations must be erected. The cost of such work is eliminated by using single sets.

Additional Panels for Multiple-Operator Set

A welding or outlet panel must be provided for each operator in the case of multiple-operator sets. In addition, enough welding panels must be provided to insure a sufficient number of them being available when required in any welding position. To meet this condition, users have bought from 10 to 50 panels with each 1000-ampere set; but, regardless of the number of panels, only 1000 amperes is available with such a set. The panels weigh from 300 to 500 lb. each and are of such size that they are frequently mounted on special overhead supports or on wheeled bases. The cost of the panels and supports or bases must be added to the cost of multiple sets.

It has been claimed that 15 or more operators may use one 1000-ampere or one 1500-ampere set. Should 15 operators weld simultaneously, and the set is not overloaded, each operator would be restricted to 100 amperes, when using the 1500-ampere set, and 67 amperes with the 1000-ampere set. Restricting an operator to 100 amperes or less prevents good welding, except for light materials. An extreme case of 15 operators striking arcs simultaneously would result in a 3750-ampere load on the 1500-ampere set, if we assume the surge current to be 2½ times the 100-ampere allowable welding current. As the arc must be frequently struck due to changing electrodes as well as due to an unsteady arc, the flash currents provide a considerable increased load on the set. The more the set is overloaded, the greater will be the instability of the arc and possible blowing out of the arc, resulting in welds which are not as good as may be readily obtained by using single-operator sets. Also the rate of welding is reduced by such objectionable conditions.

Comparative Initial Cost Figures

If the cost of the equipment is to be the determining factor, regardless of the characteristics of the welds, it is necessary in the case of multiple-operator sets to include the cost of the motor-generator set, welding panels, installation and foundations for the set and panels, as well as the material, installation and maintenance of the welding circuit. The feeders which are necessary for power and lighting are used for driving the single-operator sets.

An example of comparative costs based on a 1000-ft. shipbuilding way with buses on both sides of the way and allowing a 5-volt drop, follows.

The cost of a multiple-operator outfit is first listed:*

1500-ampere multiple-operator set	$ 2,950
Ten 200-ampere outlet or welding panels	2,500
Fifty outlet receptacles	400
Installation of set	200
Bases or supports and protecting covers for 50 outlet panels	600
Cable and accessories	6,300
Labor for installing cable and accessories	3,780
Total	$16,730

Where welding is to be undertaken for shipbuilding and other work widely separated, ten outlet panels are insufficient. Such installations require up to 50 outlet panels for each 1000-ampere set, which will add as much as $10,000 more to the cost of such an installation.

Now let us look at the cost of single-operator sets:

Ten 200-ampere single-operator sets	$5,600
Cost of 10 outlets on power feeder	80
Total	$5,680

*Another example is given below as to the cost of a multiple-operator installation on a shipbuilding way with one 1000-ampere welding set on each side. In this case 18 welding outlet panels are provided for each welding set with cable connected to two 18-circuit panels:

2 1000-ampere multiple-operator sets	$ 4,400
36 200-ampere outlet panels	9,000
2 18-circuit panels	100
Cable and accessories	500
Total	$14,000

Note that while the multiple-operator set and outfit installed costs $16,730 to $26,730 as compared with $5,680 for 10 single-operator sets, only 1500 amperes is generated with the former whereas 2000 amperes can be furnished by the single-operator sets.

A 1500-ampere multiple-operator set is approximately 100 in. long, 44 in. wide and 52 in. high. A 200-ampere welding panel is about 28 in. wide, 15 in. deep and 40 in. high. Ten panels placed alongside each other require a space 23 ft. long, 40 in. high and 15 in. deep, in addition to the space previously mentioned as required for the motor-generator. If 50 panels are provided, this space will be five times as great as for 10 panels. Ten 200-ampere single-operator sets occupy a space 23 ft. long, 30 in. high and 50 in. deep.

With the multiple-operator set, it has been found that the current is not as readily suited to conditions of welding. The current increases rapidly as the arc length decreases, the amount of current being directly proportional in drop to the resistance in series with the arc. The result is a high inrush of current and the possibility of readily burning the metal. A large manufacturer of automobile parts reported that 17% of the welds were defective when using constant-potential machines. On similar work, when using single-operator machines, the defective pieces were reduced to 3%.

Comparative tests on tank welding showed that 220 kw.-hr. and 15 hr. time were required with a constant-potential machine, whereas 75 kw.-hr. and 11¾ hr. time were required for similar welding when using a single-operator machine. The large difference is attributed to interference of the arcs with each other when using multiple-operator sets, and the fact that the arc was more uniform and constant with the single-operator machine.

Remote Control Now Available for Single-Operator Sets

Recent developments along the line of remote-control devices increase the desirability and decrease the welding costs of single-operator sets. One of these devices allows the operator to raise or lower the generator voltage merely by tapping the electrode on the work, making additional cables or a rheostat unnecessary.

Remote-control devices are particularly valuable where the operator is required to work at a distance from the machine, as in shipyard or structural work. The operator can change from vertical to horizontal welding, from one size of electrode to another, and automatically change the current without returning to the machine to reset the controls. The highest-quality weld metal is assured, since there is no temptation on the part of the operator to use the original setting rather than return to the machine. Such devices permit the use of the most efficient electrodes and therefore insure the highest possible speeds. The savings in time are obvious; in one shipyard, the welding operating factor was greatly increased.

It has been claimed that by using a synchronous motor for driving multiple-operator sets the power factor may be improved. This would be true if the load on the motor-generator were constant and were less than the total generator capacity. Such conditions are impracticable. In order to adjust the generator properly for power-factor correction, it would be necessary to station an attendant solely for that purpose. Also, if the generator is run at lig loads the efficiency will be even less than the low amount already given.

Starting and Stopping Generator Automatically

As devices are now available which automatically start single-operator sets when the electrode is touched to the work, and automatically stop the motor-generator when welding has ceased for about one minute or other predetermined time, the power factor is not affected by single-operator sets. It should be stated that the automatic starting and stopping is accomplished without the use of any wiring beyond the welding set other than the single-conductor welding lead, and it is not necessary for an operator to operate any device except to follow the conventional welding procedure. This further results in no power whatever being used by single-operator sets when they are not actually welding. This will result in a saving in cost of current up to $60 a year for each single-operator welding set.

In view of the foregoing, the only type of multiple-operator set which is recommended, and then only upon special conditions, is that having one motor driving two or more generators so that a separate generator is available for each operator. The welding conditions are then similar to those for single-operator sets. The automatic start and stop devices may also be used.

Welding Courses Offered in Indianapolis

Courses in welding to be offered by the Y. M. C. A. in Indianapolis, Ind., will begin on Sept. 25th, with Russel W. Pursel, of the Indianapolis Power & Light Co., as instructor. A course will be offered in gas welding and one in arc welding, each class meeting on Tuesday and Thursday nights for 14 weeks.

Softens Hard Spots With Torch Before Drilling

A farmer recently had occasion to have several holes drilled in a chilled moulding board for his plow. After calling on several shops and traveling some 50 miles, he took the job into the shop of Bell & McGillivary, in Sterling, Mich. After inquiring whether holes could be drilled in such metal, he was assured by Mr. Bell that it was quite simple. Thereupon, Mr. Bell lit his welding torch and heated to a dull red the several spots in the board where holes were to be drilled, then allowed them to cool slowly. He was then able to drill the holes very easily, finding about the same hardness as ordinary cast iron.

Welded Flagpole Reaches Height of 107 Ft.

A flag pole, extending 107 ft. above ground, was recently built by D. D. DeTrow, of Maumee, Ohio, for Pearson Park. This pole, said to be the largest in that part of Ohio, is of all-welded construction, and shortly after its erection it successfully withstood a very severe windstorm that wrecked barns, houses and trees in that neighborhood. The base of the pole is of 12-in. extra-heavy pipe and extends 11 ft. into a concrete base of 47 tons weight. A cast-iron eagle, with a 28-in. wingspread, is mounted atop the pole.

Cleveland Section Plans Winter Program

The Cleveland Section of the American Welding Society are planning a series of six meetings to be held on the second Wednesday of each month at the Cleveland Engineering Society rooms in the Hanna Building. Officers of the section are: Chairman, A. E. Gibson, vice-president of the Wellman Engineering Co.; 1st vice-chairman, Jack Carbis, of Williams & Co.; 2nd vice-president, Robert E. Kinkead, consulting engineer; and secretary-treasurer, E. T. Scott, president of the Cleveland School of Welding.

Steel Fabricators to Hold Meeting

A complete report on the code situation, as it affects the structural-steel and iron-fabricating industry, will be given at the 12th annual convention of the American Institute of Steel Construction, to be held in Chicago, Oct. 24th to 26th, at the Edgewater Beach Hotel. All those in the industry, including non-members as well as members of the Institute, are invited to be present. Further details of the meeting can be obtained from the Secretary, 200 Madison Ave., New York, N. Y.

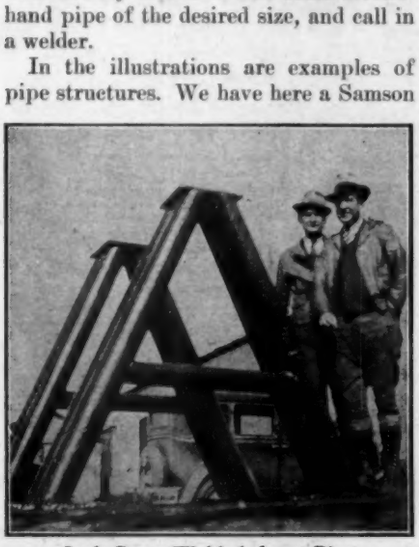
Welded Oil-Field Equipment Built Up From Piping

By M. L. ROGERS

Pipe has a feature possessed by no other structural steel member: It has an equally high resistance to bending, regardless of the location or direction of the load.

In the oil field, to build a structure of steel usually means to find some second-hand pipe of the desired size, and call in a welder.

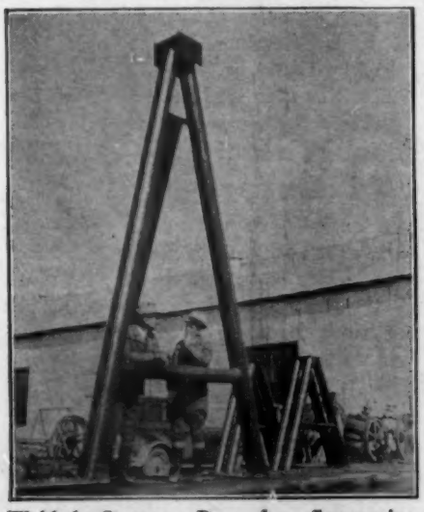
In the illustrations are examples of pipe structures. We have here a Samson



Jack Posts Welded from Pipe.

post (the tall structure) and two jack posts, all welded. Very artistic, they are, compared with the old-time wooden Samson posts and jack posts! Not only are they neater in appearance, but they will last indefinitely if kept painted, and can easily be moved from one location to another, while wooden members soon rot away or split.

A bearing is bolted to the plates on top of the Samson post for the walking beam to work on, as one of the illustrations shows. The Samson posts must support the walking beam and a counterweight for the jet rod—a total load of several tons. Some wells have over a mile of 1-in. or 1⅛-in. jet rod tugging at the end



Welded Samson Post for Supporting Walking Beam for Oil-Well Pump.

of the walking beam, so the working stress is apt to be very high.

These steel structures were manufactured by the Nourse Watson Machine Works, of Seminole, Okla., who find ready sale for these steel fronts made of scrap pipe, and also find it very profitable.

Other types of devices welded up from pipe for use in the oil fields include pump skids, engine skids, lubricator skids for boilers, trailer and trailer coupling poles, back ends for truck beds, fishing tools, and hot-water heaters for heating the water with exhaust from the boilers.

Retaining Strength and Ductility in Manganese Steel

By G. J. SLIBECK
Stulz-Sickles Co.

Manganese steel will work-harden under impact to an unusually high degree. It also has the properties of toughness and ductility, and is impervious to abrasion except with an emery wheel. It is relatively inexpensive to manufacture. Hence, it meets certain requirements better than any other known metal, and today it is the accepted steel for certain purposes.

Manganese steel was discovered by an Englishman by the name of Hadfield, and it was brought to this country about 30 years ago. The railroads saw the possibilities at once of using this steel for their frogs and crossings and were the first industry to use it. Later, industrial firms began experimenting with it and found that it could be used in certain of their work also.

The composition of Hadfield or high-manganese steel is as follows:

Carbon	1-1.40%
Manganese	10-14%
Phosphorus	.06-.10%
Silicon	.30-.50%
Sulphur	.02-.05%

The tensile strength is 125,000 lb. per sq. in., and the yield point 35,000 lb. per sq. in.

The composition is varied to obtain the qualities desired in the casting. As examples, a tough mild manganese is desirable for a railroad frog and a tough hard manganese for a crusher head.

To get the best results out of manganese steel, it must be used where an impact meets the wearing surface so as to work-harden it. For instance, it is satisfactory as a railroad frog or a stone crusher but is not so good in clay machinery.

The steel comes to the customer with an initial surface hardness of 170 to 200 Brinell, and since this surface is cold-worked by impact of some kind, it gets harder and harder until it reaches about 450 to 500 Brinell, and then it begins to spawl off.

This cold-working extends down into the metal, and at a hardness of 500 Brinell it has reached a depth of about 5/8 in. This hardness results in a packing down of the metal upon itself, so that at about 500 Brinell it is 3/16 or ¼ in. down from its original height. This hardening or packing down plays a most important part in the welding of manganese and must be taken into account if the weld is not to fail.

When a manganese steel casting is removed from the mold, it is very brittle and has no commercial use until it has been heat-treated. Therefore, it is placed in a furnace and heated above 1830°F., then immediately quenched in water. It is then the manganese steel that we know.

When manganese steel is poured, a microscopic examination reveals that the carbon silicates, which form the cementite that binds the grains together, are not in solution but are scattered among the grains of manganese and are segregated one from another. The effect of furnace heating is to put these carbide silicates in solution so they will cover and surround each particle of manganese, and the rapid quenching stops them in solution.

When 450 to 500 Brinell has been reached, the cementite has been squeezed out from between the grains of manganese, leaving nothing to hold them together. This results in spawling, which is a breaking down along the slip-planes. In order to weld a piece of manganese steel properly, this hardened surface must be ground away and parent metal reached, otherwise there is nothing in the hard-packed surface metal to hold the weld.

In welding, rods should be used containing carbon and manganese of somewhat varying percentages from those in high-manganese steel, and there should be a certain amount of nickel introduced, which enables one to get the same result as obtained with water quenching.

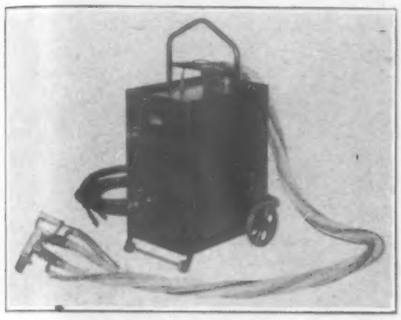
Obviously, if a piece of manganese steel were heated in order to weld it by a flame or fire of any kind, the heat-treatment would be taken out of it. When we weld it, we not only must leave the treated steel but must produce a weld that will be tough and ductile. Nickel is not readily oxidized in molten steel and has the effect of retarding the rate of transformation; it therefore tends to reduce the grain size and increase the elastic properties and toughness of the steel.

The question of the proper mix of a nickel-manganese welding rod is very important. Too much carbon in the rod will make a brittle weld. An incorrect proportion of carbon and manganese will cause a poor rod. The proper portion of silicon in a rod is most important. Therefore, there is considerably more to the welding rod than simply the act of welding with it.

New Equipment

New General Electric Stud Welder

A new portable stud welder, consisting of a welding transformer and control mounted in a portable steel cabinet, primary and secondary cable, and a stud-welding gun, has been made available by the General Electric Co., Schenectady, N. Y. The stud welder is an equipment for fusing the end of a stud into a metal surface. Applications include welding studs to steel surfaces for



Transformer and Gun for Stud Welding.

hanging piping, conduits, signs, instruments, hooks, and insulating materials.

A stud is placed in the welding gun, pressed against the surface to which it is to be welded, and one automatically timed impulse of power completes the weld.

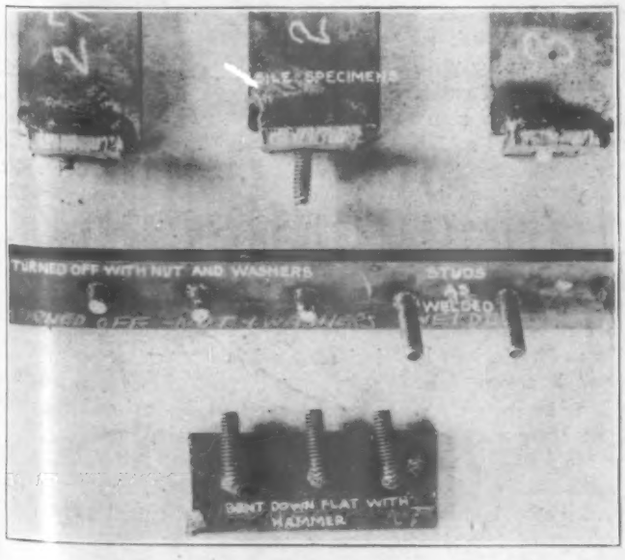
One side of the portable steel cabinet is equipped with split steel doors which give access to the control panel. Opening the upper door automatically removes the power from the panel; adjustment of current and time for different sizes of studs are made with this upper door open. The lower door is for servicing and can be kept locked.

The transformer is mounted in the cabinet behind the control panel and is connected to the power supply through a 20-ft. double-conductor drag cable. The secondary of the transformer supplies heavy current at low voltage to the welding gun through hollow, forced-air-cooled flexible cables. The cooling air is admitted at both ends of each cable and is allowed to bleed out over its entire length. The secondary windings of the transformer are also forced-air-cooled, permitting the use of the minimum of material for a given capacity; in this manner obtaining as high a degree of portability as possible. The weight of the complete unit, less the cables, is approximately 500 lb.

The welding gun is a tool for holding the stud against the work under spring pressure, and for properly directing the welding current. The gun is light in weight—most parts being of aluminum—and will accommodate studs of from $\frac{1}{8}$ to $\frac{5}{16}$ in. in diameter and from $\frac{1}{2}$ to $2\frac{1}{2}$ in. long.

A control switch in the spade-type handle of the gun controls the operation of an automatic timer located on the control panel. When the gun switch is closed, current flows for a definite period of time only, regardless of how long the switch is held closed. The timer is adjustable for periods of from 1/12 to 5/6 second, the exact time used depending on the size of stud being applied. Once adjusted, the timer repeats the desired duration of current flow for each weld.

The new G-E stud welder is obtainable for single-phase power supplies of from 25 to 60 cycles, 110 to 550 volts.



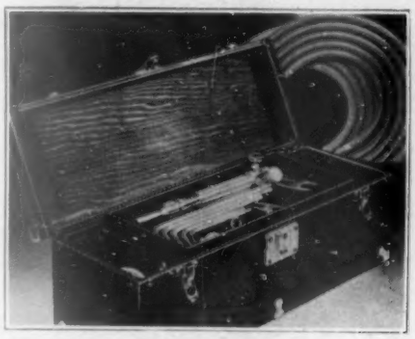
Test Specimens of Stud Welding Subjected to Pull, Twisting, and Bending.

Plumbers' Brazing Outfit for Bronze Fittings

To meet the need of steamfitters and plumbers for a reasonably priced outfit for the installation of Walseal threadless bronze fittings by the Aircobraze process, the Aircobraze Oxyacetylene Outfit has been developed by the Air Reduction Sales Co., 60 East 42nd St., New York, N. Y.

With this outfit hooked up to the gas cylinders, it is only necessary to slip the brass pipe into the Walseal fittting until it butts up against the shoulder, and apply the Aircobraze process to the pipe and fitting until the white ring of Sil-Fos appears around the pipe—visible evidence that the joint has been made. This same outfit is also entirely suitable for pipe welding.

Aircobraze Oxyacetylene Outfits will be distributed by the Walworth Company to the plumbing and heating trade



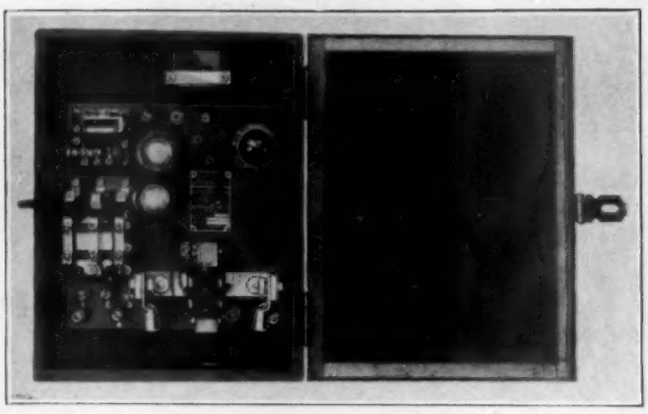
Aircobraze Oxyacetylene Outfit.

through regular plumbing supply dealers and through their district sales offices. The process is completely illustrated and described in a 4-page bulletin issued by the manufacturer.

Automatic Weld Timer Operates at High Speeds

A high-speed weld timer for use with resistance welding machines has been put on the market by The Electric Controller & Mfg. Co., 2702 East 79th St., Cleveland, Ohio. This device, known as the Folio 2 EC&M Automatic Weld Timer, varies the welding time in inverse proportion to the rate of current flow, as does the Folio 1 Weld Timer, which has been on the market for many months, but in addition the new device is twice as fast in operation, it has an adjusting dial for varying the time, and allows a selection of any of three ranges of current. Moreover, it contains less apparatus than the Folio 1 Timer and the dust-tight enclosing cabinet is smaller.

The faster operation of this new timer not only makes it possible to produce many more welds per minute on any given material, but it also greatly increases the number of different kinds



Automatic Control for Timing Resistance Welds.

and also the variety of thicknesses of metals which now may be satisfactorily welded under the control of this type of timing device. For example, in the case of alloys and metals of high thermal conductivity, requiring a high welding current with an extremely short time, it is possible with this new timer to use a higher heat tap on the welding machine, thus providing greater concentration of heat at the weld, and at the same time securing closer control of the number of heat units put into each weld.

With the triple current range control, the change from one range to another is quickly obtained by inserting a plug into one of three receptacles located on the front panel, making possible a highly refined control of the length of time the current is on.

With both the Folio 1 and Folio 2 Timers, the length of time the current is on is inversely proportional to the current itself. Therefore, once the timer is properly set for the material at hand, consistently good welds are obtained without further adjustment, regardless of variations in thickness of the material or condition of its surface as regards scale and dirt.

Portable Ventilator for Removing Welding Fumes

A new portable ventilator for removing welding fumes from enclosed compartments, has been developed by the Coppus Engineering Corp., Worcester, Mass. Though especially designed for shipyard work where much welding is done in enclosed spaces, this unit is equally useful for ventilating such confined spaces as tanks, drums and other vessels in process of welding.

Using Ventilator in Shiphold.

This ventilator is very compact in design and can be lowered through a 14-in.-diameter opening. As the total weight, including electric motor, is only 80 lb., it is readily portable and can be quickly set up and put in operation by one man.

Flexible tubing, 8 in. in diameter, may be used to carry off the fumes and foul air at a rate of 1500 cu. ft. of air per minute.

The ventilator can be used in either a horizontal or vertical position. When placed in a vertical position, the ventilator rests on a ring attached to the inlet, so that the fumes are removed from the very lowest point.

"Stroco" Arc Welders Have Constant-Current Control

A line of arc welders, manufactured under the trade name "Stroco," has been announced by the Rich Manufacturing Co., Ltd., 3851 Santa Fe Ave., Los Angeles, Calif. These welders have separate excitation, self-stabilization, and an automatic current control device that obtains constant amperage even though the arc length might vary.

With separate excitation, the time constant has been reduced to such an extent, it is claimed, as to result in quick arc recovery. The elimination of external stabilizing devices is said to result in a highly efficient machine and a high degree of arc stability.

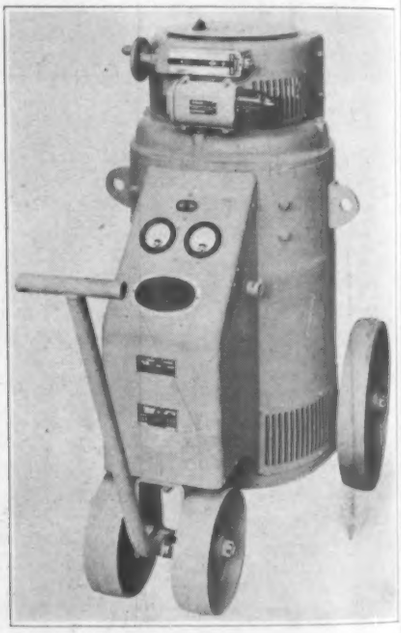
The current control device is an important factor in securing excellent welds of uniform penetration, since it is said to provide a constant amperage corresponding to the setting of the control, and amperage and penetration are therefore uniform regardless of variations in arc length. The current is governed by the position of the brushes, which can be shifted to vary the amperage output.

Stroco arc welders are available with motor drive and gasoline-engine drive, in both stationary and portable units. They are made in ratings of 200, 400, 600, 800 and 1000 amperes. They are said to stand an intermittent overload of 35%, and to operate satisfactorily at as low as 20% of rating.

New Welders Announced by J. D. Adams Mfg. Co.

A line of d.c. arc welders is announced by the J. D. Adams Manufacturing Co., Indianapolis, Ind., in sizes of 200, 300 and 400 amperes, 40 volts NEMA rating, and with motors, in the motor-generator type, rated at 220 or 440 volts, 3 phase, 60 cycles. These machines are also available with gasoline-engine drive.

Among the features of this new line of welders, the manufacturer lists the following: (1) A high overall efficiency of 56% to 64%. (2) Arc recovery under short circuit in 1/400th of one second under full NEMA rated load. (3) Short-circuit surge considerably below the maximum tolerance as set by the U. S. Navy. (4) High overload capacity. (5) Temperature rise at full NEMA rated load in one hour against grid resistance is much below the 50° C. rise permitted by NEMA standards. (6) The gyroscopic action, which is a result of the vertical style of mounting, reduces vibrations under shock load. (7) The life of the welder is increased by forcing cooling air in at the top and out at the bottom.



Vertical Type of Arc Welder.

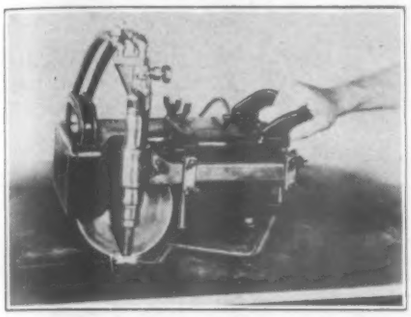
It is claimed that the vertical mounting and the system of cooling greatly reduce the amount of grit and iron particles that are picked up and which are destructive to the windings.

These welders are being introduced only after exhaustive laboratory tests as well as tests under actual shop conditions.

New Cutting Machine Added to Airco Line

The Airco-DB Tractograph, latest addition to the Airco-DB line of oxy-acetylene cutting machines, manufactured by the Air Reduction Sales Co., 60 East 42nd St., New York, N. Y., is said to provide a simple means for accurately producing shapes having straight, circular or irregular outlines. It will cut plates and slabs up to 2 in. in thickness and of practically unlimited areas.

It is a small, compact, motor-propelled unit which can be quickly adjusted to travel at any speed from 2½ in. per minute. As it travels, it is guided by hand along the desired contour laid out and scribed directly on the plate or slab.



Portable Hand-Guided Machine for Gas Cutting of Shapes.

This new machine will easily turn sharp corners and follow both simple and intricate contours with unusual accuracy. Once the operator has set the travel speed, lit the torch and pressed the starting switch, he can confine his attention to guiding the machine. No special skill is required to cut beveled or perpendicular edges. Cuts made with the Tractograph are practically as smooth as those produced by a completely automatic gas cutting machine.

Measuring only 7¼x8¼x16 in., and weighing but 48 lb., the Tractograph can be easily carried about and used wherever 110 volts, alternating or direct current, is available.

Line of General Electric A. C. Welding Equipment

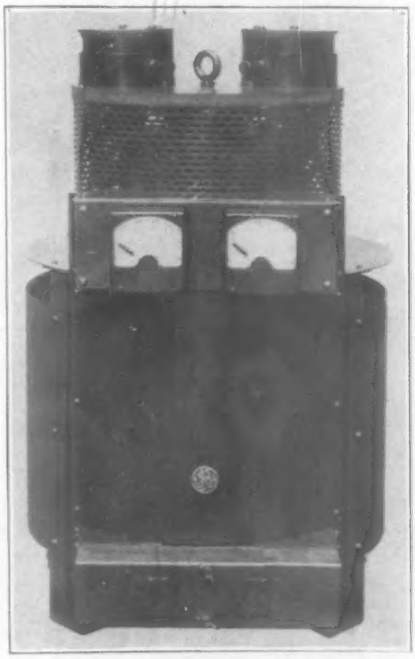
In addition to its line of direct-current arc-welding equipment, the General Electric Co., Schenectady, N. Y., now has available a complete line of alternating-current arc-welding equipment, including transformer units, electrodes, and automatic welding heads and control. The new a.c. equipment is intended for heavy-current welding—primarily automatic welding because of the heavy current involved, but otherwise equally well suited to hand applications.

A.c. arc welding is not new, but the remarkable development of arc-welding electrodes during the last few years has only recently made it possible to benefit from the major advantage of the a.c. process—that advantage being the absence of magnetic blow in the arc, and therefore superior quality in the resulting weld. It follows, of course, that this advantage becomes particularly apparent with the heavier welding currents (above 250 amperes) because of the greater magnetic effect at these currents. Slightly greater welding speeds are possible when using alternating current; and in making fillet welds and in working into corners and other parts of intricate structures, the a.c. arc allows full penetration to be obtained.

The new transformer units are available in three sizes having one-hour ratings of 500, 750, and 1000 amperes. Primaries are wound for 220, 440, or 550 volts; 60, 50, or 25 cycles; single phase. Extra attachments are available for reducing the secondary open-circuit voltage to approximately 50% of its normal value (normal being 80, 90, or 100 volts) and for obtaining currents down to 10% of the one-hour rating.

The transformers themselves are of the high-reactance type, air-cooled and enclosed in a sturdy cylindrical shell. A suitable arrangement is provided to vary the reactance so that the full welding range of the equipment can be obtained on any one of three secondary open-circuit voltage settings—the latter being selected by means of taps on the primary winding.

The electrode recommended is the General Electric Type W-23, a heavily coated electrode especially suited to a.c. welding.



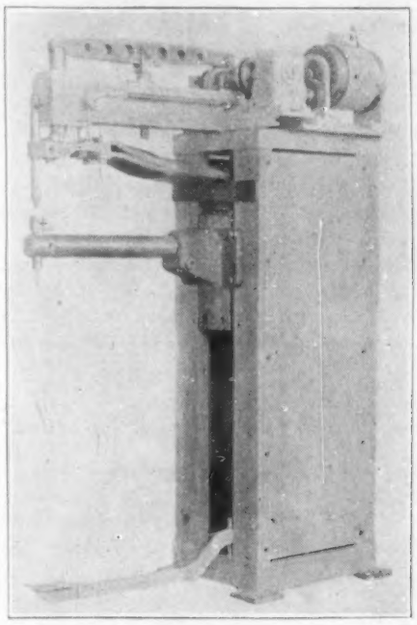
Large-Capacity A. C. Welder.

The new a.c. equipments are intended primarily for shop use in semi-permanent locations, a lifting eye being provided for handling by crane.

Making Invisible Spot Welds

A new line of automatic spot-welders, incorporating the principle of synchronous control, has been developed by the Roth Welding-Engineering Co., Inc., Box 56, North End Station, Detroit, Mich. These new welders, known as "Roth-Synchromatic," are said to make spotwelds that are invisible. They are especially designed for spot-welding work where metal finishing counts, as well as for welding stainless steel, brass, aluminum, and various alloys.

The machines are driven by a synchronous motor, which operates the upper electrode as well as the synchronous contactor. Very exact timing, from one-half cycle up, is obtained. The contactor can be adjusted to break the load near the zero line of the sine-wave and thus avoid arcing.



Roth Synchromatic Spot Welder.

The upper electrode is vertically straight guided to insure a perfect contact and uniform wear of the electrodes. Extremely long life of the electrode points is a result of the use of exceedingly short welding time.

These welders are manufactured in several sizes, from 15 to 60 kva.

Correction Regarding Description of Helmet

The No. 660 helmet, a new development of the American Optical Co., Southbridge, Mass., for protection against eye injuries and disfigurement of the face, is not recommended for protection against fumes as was stated in the description of this helmet in the August issue of *The Welding Engineer*. This helmet contains clear lights of laminated glass and is not intended to pro-

tect welders' eyes from the injurious rays encountered in the welding process. Where welding is involved, this helmet may be worn over the welding goggles.

New Heavy-Coated Electrode Welds at High Speeds

A new heavily coated arc-welding electrode, designated as G-E Type W-23, for the economical production of high-speed, high-quality welds in the flat position, has been announced by the General Electric Co., Schenectady, N. Y. This electrode is suitable for either manual or automatic arc welding and will produce equally good results on alternating or direct current. With the latter, reverse polarity is used.

The element of economy in the production of high-quality welds is provided by the ability of Type W-23 electrode to operate at higher speeds, in larger diameters (¼, 5/16, and ⅜ in.), and at higher current values than those commonly in use. Another economy-promoting characteristic claimed is the fact that welds made with Type W-23 electrodes fuse uniformly with the side walls of the joint, thus saving the time and labor ordinarily spent in chipping out slag from pockets at the line of fusion.

Welds made with the new electrode are said to be smooth and of excellent appearance, and to possess exceptional tensile strength, density, ductility and resistance to impact and corrosion. They more than meet the requirements for Class 1 (A. S. M. E. Boiler Code) and E-10 (A. W. S. Tentative Filler Metal Specifications). This electrode has also been approved by the American Bureau of Shipping for Class 1 (E-10 A. W S. Spec.) welding in the construction of hulls and machinery subject to classification by the Bureau.

Typical physical characteristic values for W-23 welds are tabulated below:

After stress relieving at 1200° F.

	Results of 5 tests Average	Range
Ultimate tensile strength, lb. per sq. in.	65,840	65,400-66,700
Yield point, lb. per sq. in.	54,460	50,800-56,600
Per cent elongation in 2 in.	31.6	29.5-34.5

Without stress relieving

	Results of 9 tests Average	Range
Ultimate tensile strength, lb. per sq. in.	69,550	67,400-71,300
Yield point, lb. per sq. in.	56,355	50,500-60,300
Per cent elongation in 2 in.	27.2	24.5-30.

Impact resistance, 30 to 40 ft.-lb. (Charpy).
Free-bend ductility values range from 40% to 60%.

Trade Literature

"The Fiftieth Year" is the title of an attractive book just published by the Harnischfeger Corp., 4513 W. National Ave., Milwaukee, Wis., in commemoration of their golden anniversary. Beautifully bound in gold and purple, and profusely illustrated throughout its 84 pages,

P&H Golden Anniversary Book.

this book tells in an interesting and impressive way the story of the beginning and development of an organization who pioneered many types of equipment that are now quite generally used in industry. Among other things, the important part this company has played in the development of arc welding is related. Copies of the book are available to executives and to patrons of the company.

Magnaflux, described as a rapid, non-destructive method of locating defects in steel and magnetic alloys, is discussed and various applications described, including the inspection of welds, in a folder issued by the Magnaflux Corp., 25 West 43rd St., New York, N. Y. Illustrations show equipment used and various types of work to which this method is applied.

"Pressure Regulators and Regulation Problems" is the title of an illustrated 16-page booklet written to give the user of oxygen and acetylene a better understanding of regulator design, care and operation. Copies of this publication can be obtained from the Air Reduction Sales Co., 60 East 42nd St., New York, N. Y.

The complete line of "Stroco" mild-steeel and alloy welding rods and electrodes are listed and described in a 16-page catalog issued by the Rich Manufacturing Co., Ltd., 3851 Santa Fe Ave., Los Angeles, Calif. Recommended procedures and amperages are given.

"Work You Can Profitably Do With 'Simplified' Arc Welding" is the title of an illustrated folder issued by Hobart Bros, Box U-94, Troy, Ohio, setting forth some of the advantages of welded design and construction.

General specifications for Type SA welding generators, belted or direct driven, of 300, 400 and 600 amperes are given in Bulletin No. 303, issued by The Lincoln Electric Co., Cleveland Ohio.

A leaflet outlining the advantages of arc welding in the construction and repair of steel bridges and buildings has been issued by the Northern Bridge Co., 10 S. La Salle St., Chicago, Ill.

The "Strobel" electric-arc saw is illustrated and described in a new leaflet being distributed by the Rich Manufacturing Co., 3851 Santa Fe Ave., Los Angeles, Calif.

A new instruction book in Spanish, covering their complete line of welding electrodes, has been issued by The Lincoln Electric Co., Cleveland, Ohio.

Commercial News

Cleveland to Have Welding Clinic

A 3-day welding clinic will be held in Cleveland, Ohio, Sept. 27th to 29th, with the Cleveland branch of The Linde Air Products Co. acting as hosts. This clinic, which is one of a series being held by this company in different industrial centers, will be conducted at Chester Ave. at East 30th St. The purpose is to dispense information on new developments in oxyacetylene welding and cutting and to assist users of the processes in the solving of their problems.

Each day's program begins at 8 a. m. and continues through to 5:30 p. m. In addition, on Friday, the 28th, when there will be an evening session lasting until 10:30 p. m. No charge will be made for attendance.

Not less than 12 work tables will be used, at six of which will be experienced operators to give individual instruction. Motion pictures will be shown. A representative will be present from the Aluminum Co. of America and one from the Chase Brass & Copper Co. to advise on the welding of aluminum and on soldering sweat fittings to copper pipe.

European Trip Reveals Good Business Abroad

Upon returning recently from a combined business and pleasure trip in the British Isles and continental Europe, W. H. Hobart, executive vice president of the Hobart Brothers Co., Troy, Ohio, expressed surprise at the great amount of industry evident in a number of the countries visited, in the light of newspaper reports of their condition.

At the same time, he states that he cannot conceive of those countries ever approaching the United States again in world influence or in their own internal progress, particularly with reference to the status and welfare of the working classes.

Mr. Hobart reports that his company's interests are well served abroad, but that domestic business has developed far more rapidly during the past twelve months, with the marked revival of demand for welding machines.

Hollup Corp. to Have New Factory

A contract for the construction of a new factory has been let by the Hollup Corp., of Chicago, who have outgrown their present quarters. The new building, consisting of one story 170x290 ft., will be located at 3351-3363 West 47th St., or about a block from the company's present location on West 48th Place.

The new plant will have an extruding room, with temperature control, for producing the coatings on shielded-arc electrodes. In addition to the usual factory facilities, there will be an air-conditioned general office, sales conference room, four private offices, display room, machine shop, physical laboratory and chemical laboratory. The plant will have a railroad spur on one side and trucking facilities on the other.

"Goodie" Lands Some Real Fish

Four black bass, "beautiful and plump," totaling 19½ lb. in weight and a 5½-lb. wall-eyed pike were recently taken on a 15-mile boat trip by H. A. ("Goodie") Goodwin, district manager of The Bastian-Blessing Co. Chicago, along Sand Creek and Red Cedar River in northern Wisconsin. "Goodie" figures the total cost of the trip at $9 per bass, which includes trekking the boat. "Fell out of the boat but once," he reports.

Meriam Co. Enlarges Its Welding Department

The entire pace in the present plant of The Meriam Co. at 1955 West 112th St., Cleveland, Ohio, is to be given over to the welding division and to the manufacture of flow and pressure instruments. The department devoted to the rebuilding of gas and oil engines will be housed in a new building now under construction. This plant has expanded during the past six years from a small shop at 8405 Detroit Ave. to the present plant of about five times the original capacity, and now a further increase in space is required, reports J. P. Meriam, president.

Tenney Recovering From Broken Neck

G. E. Tenney, Chicago district manager of The Lincoln Electric Co., had one of his neck vertebrae fractured and six vertebrae dislocated on the morning of Sept. 9th, when he was mounting a horse for his accustomed Sunday morning ride. One foot was in the stirrup when the horse shied, and Tenney was thrown over backward, landing on his head. Despite the extreme seriousness of the accident, he is reported to be making progress and full recovery is expected.

Large Export Shipment of Acetylene Generators

A carload of model 12-P Sight Feed acetylene generators was recently sent to New Zealand by The Sight Feed Generator Co., of Richmond, Ind. This is one of the largest, if not the largest, single orders for acetylene generators ever placed in the United States.

This purchase is one of the steps in the modernization program of the New Zealand government railways, who have been using welding for maintenance work for many years, and now contemplate an expansion of their welding program. The first "Sight Feed" generators were purchased by the New Zealand railways about five years ago.

Death of McKay, Noted Inventor

The death of W. F. McKay, a well-known figure in the compressed-gas manufacturing field, occurred on Aug. 16, following an illness of about 10 weeks. In 1930 Mr. McKay became affiliated with The Linde Air Products Co. as special sales engineer, and at one time he was connected with the International Oxygen Co. He was the inventor of the McKay gas valve and of other devices related to the compressed-gas industry. Since 1929, he served as chairman of the Safety Device Committee of the Compressed Gas Manufacturers' Association.

The Aladdin Rod & Flux Manufacturing Co., of Des Moines, Iowa, announces the following appointments as jobbers for their products: Southern Minnesota Supply Co., Mankato, Minn.; St. Cloud Auto Supply Co., St. Cloud, Minn.; D. S. Milne Co., Fairmont, Minn.; Hub City Iron Co., Aberdeen, S. D.; Sioux Falls Machine Works, Sioux Falls, S. D.; Cave Supply Co., Watertown, S. D.; Quanrud, Brink & Reibold, Inc., Bismarck, N. D.; Lindberg-Maddison Welding Co., Hibbing, Minn.; Scheffer & Rossum Co., St. Paul, Minn.; Ross Frazer Iron Co., St. Joseph, Mo.; French Co., Columbia City, Mo.; and Newkirk Sales & Service, Waterloo, Iowa.

The Sight Feed Generator Co., Richmond, Ind., announces the appointment of the following distributors: Auto Parts Service, La Crosse, Wis.; John Bourchard & Sons Co., Nashville, Tenn.; Huntington Forge & Machine Co., Huntington, W. Va.; Miller Co., Waco, Texas; Motor & Electric Supply Co., Bowling Green, Ky.; Motor Supply Co., Enid, Okla.; Orgill Brothers & Co., Memphis, Tenn.; Roper, Harris & Dunn, Greenville, Texas; Young & Vann Supply Co., Birmingham, Ala.; and Oliver H. Van Horn Hardware Co., New Orleans, Shreveport and Huston, La.

The Machinery and Welder Corp., Chicago, Ill., have moved into larger quarters at 312-14 N. Sheldon St., which has double the floor space which was available in their former location, which was next door at No. 316. This company, founded three years ago, distributes a complete line of arc-welding equipment and acetylene equipment and supplies, and also rents arc-welding equipment.

The Universal Power Corp., Cleveland, Ohio, announces the appointment of the Larkin Equipment Co., International Harvester Bldg., Albany, N. Y., and the Silver Welding Service, West Roxbury, Mass., as distributors of the company's arc welders, electrodes and supplies.

The Allsteel Press Co., 12015 S. Peoria St., Chicago, Ill., have appointed L. Ray Phipps, 918 Lepeer St., Flint, Mich., as exclusive representative in Flint, Lansing, Saginaw and Bay City, for the "Verson" line of all-steel punch presses.

Thomas H. Simpkins, manager of the Logansport Oxygen Co., Logansport, Ind., passed away on Sept. 7th after a serious illness which confined him to his bed since last March.

The Tupes Welding & Supply Co., 535 Peck St., Muskegon Heights, Mich.,

have changed their name to Tupes Spring & Welding Service, and have added a line of automotive springs in addition to their welding supply business.

The New York office of Tube Turns, Inc., has been moved from 30 Church St. to the Bowery Savings Bank Building at 110 East 42nd St. W. P. Curley remains as district manager, with I. A. Pfeil as his assistant.

The Torchweld Equipment Co., of Chicago, announces the appointment of the Metropolitan Welding & Supply Co., 112 Colfax St., St. Albans, N. Y., as distributor of their welding and cutting equipment.

Miles C. Smith, formerly of the Stoody Co., Whittier, Calif., has been appointed sales manager of the Welding Division of the Rich Manufacturing Co., Ltd., Los Angeles, Calif.

Roy Hurt has been made manager of the Gas Products Co., Cleveland Division, with which is combined the National Oxygen Co.'s Akron district. His headquarters will be in Cleveland.

The South Park Welding Works, 2624 Connor St., Port Huron, Mich., have taken on the distribution of cast-iron brazing flux manufactured by the Pratt-Brayman Co., of Oscoda, Mich.

C. J. Haines, vice-president of the National Cylinder Gas Co., Chicago, recently returned from a European business trip of several months' duration.

D. O. Lindeblad has been appointed service engineer by the Torchweld Equipment Co., with headquarters at the company's plant in Chicago, Ill.

The Republic Steel Co., Youngstown, Ohio, announces the appointment of the Buhl Sons Co., Detroit, Mich., as distributors of Toncan Iron.

Harvey Winkleman, formerly with the Patterson Supply Co., Cleveland, Ohio, is now with the Gas Products Co., also of Cleveland.

T. R. Williams, who formerly operated the Welders Supply Co., Muncie, Ind., has opened a similar business in Richmond, Ind.

Notes From the Field

Preheating Furnaces Made of Carbide Cans

Another use is found for carbide cans. In A. H. Bond's Welding Shop, Grand Rapids, Mich., the can is used as a salamander for preheating small jobs. The top and bottom are cut out of the can, then a grate is inserted about one-third of the distance down from the top, and air-vent slots are cut in the sides near the bottom. This device is economical in charcoal consumption, only a handful or so being required.

The National Electric Welding Corp., of Huntington Park, Calif., has contracts for structural-steel reinforcing by welding in the Fine Arts High School building at Inglewood, and also in the State Street School at South Gate. This welding meets the requirements of the new state safety building code as regards protection against earthquake shocks.

E. F. Cleveland was recently appointed welding inspector and placed in charge of the plate shop of the Maywood plant of the Consolidated Steel Corp., of Los Angeles, Calif. Mr. Cleveland, who has been with the Consolidated company for over 15 years, replaces Hollis Leake, who recently resigned to accept a position as umpire for the Western Baseball league.

The Western Pipe & Steel Co., of Los Angeles, Calif., has been awarded a contract for the welding work on an 80,000-barrel welded and riveted oil-storage tank for the Seaside Oil Co., near Chrisman, Calif. The roof and bottom of the tank will be of welded construction. A tank of similar specifications was also recently completed by the same company.

Nourse Watson, of Seminole, Okla., has built a new welding shop, 33x45 ft., containing a preheating furnace, an overhead hand-operated hoist for handling heavy work, and a full complement of welding equipment. An acetylene generator and an air compressor are set apart in a room separate from the shop.

The Western Pipe & Steel Co., of San Francisco and Los Angeles, reports the recent purchase of seven new 400-ampere gas-engine-driven General Electric welding units, to be used in connection with the work of completing a portion of the San Francisco aqueduct, known as the Hetch-Hetchy project.

The death of Harry Painton, a welder, which recently occurred while he was welding on a locomotive, in Rockaway, Ore., was incorrectly reported in the August issue of *The Welding Engineer* as having been caused by an exploded cylinder head. Later reports are that Mr. Painton was welding a hollow piston, and evidently failed to remove the plugs, and the piston exploded.

C. E. Ladd, formerly with The Linde Air Products Co., of Pittsburgh, Pa., has opened a welding shop operating under the name of "The Modern Welding Service," at Beckley, W. Va. In addition to a general welding business, Mr. Ladd will specialize in building up worn flanges on locomotive wheels.

The California Oil Tool Co., of Torrance, Calif., recently reopened its welding department after several months of inactivity. They feature oil-field welding, digging-bit service, and general hard-facing work. V. D. M. Smith and his son, L. J. Smith, are the owners.

F. A. Petrie, of Pomona, Calif., associated for a number of years with the Pomona Valley Machine Works, recently opened a job welding shop at 280 North Garey Ave., in Pomona. The new shop will be operated under the name of the Garey Avenue Welding Works.

Welded steel pipe is being used extensively by the city of Colton, Calif., in a program of replacing a considerable amount of its water mains. The welding is being done by the Hub City Welding Works, of Colton.

The Angeles Welding Works recently opened for business at 3454 E. First St., in Los Angeles, Calif. E. F. Ayala is proprietor of the shop, which is equipped with portable acetylene and electric equipment.

All-welded piping will be used in a new building being constructed to house the fire department of Grand Haven, Mich. The contract for the welding has been let to the Ottawa Welding Co., of Grand Haven.

The Industrial Welding Shop, Portland, Ind., recently completed a contract for the installation of six miles of 4-in. pipe, all oxyacetylene welded, for the N. E. Masters Gas Co., of Jay County, Ind.

H. Ward, recently of Chicago, has purchased the business of the Utah Spring & Welding Co., at 47 East 5th St., Salt Lake City, Utah, and is installing an electric welder. He will special-

All failed in the parent metal

★

NOT ONE FAILED IN THE WELD

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The Erie City Iron Works, Erie, Pa., recently installed a 300,000-volt oil-immersed General Electric x-ray unit, to be used for the x-ray examination of Class 1 pressure vessels.

The Iowa Welding Shop has been opened by Lawrence Gall at 409 Valley St., Burlington, Iowa. The firm is equipped for both shop and field welding.

William Nanny and Walter Otis have opened a welding and machine shop at Forest City, Iowa, equipped for both shop and field welding.

J. A. Yungers, of Red Wing, Minn., recently opened a general job shop specializing in white-metal welding and automotive work.

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Help Wanted—75c per line, minimum 4 lines. Jobs Wanted—4 lines free. Other Ads—$1.00 per line, minimum 4 lines. Count 8 words to line. Add 6 words for keyed address.

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Bargains—Demonstrator Arc Welders. Gasoline, electric drive, belted, or coupled-together outfits. 30 days' trial. Easy terms, if desired. Write Ken's Welding Exchange, Box U-941, Troy, Ohio.

Bargain!—U. S. Navy Surplus, ¼-in. heavy-coated Westinghouse Electrodes, one position, reverse polarity; 65,000 lb. tensile strength. Limited quantity. Manhattan Electrical Bargain House, Inc., 105 Fulton St., New York, N. Y.

For Sale—200, 300 and 600 ampere Transformer-type Welders; 25 and 60 cycle, 220 and 440 volts. Our stock also includes motor-generator sets. All machines guaranteed. Goodman Electric Machinery Co., 1060 Broad St., Newark, N. J.

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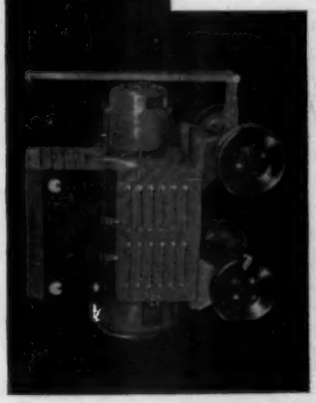

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Development Engineer—Formerly in welding department of Chrysler Corp. and in charge of methods and standards for Cord Corp. Also experienced in foundry practice. Trained to make investigations, tests and recommendations of welding procedures. Familiar with costs, time study, production control, and routings. Address S-4, The Welding Engineer.

Specialist in Plate Work—Over 15 years' experience in designing and erecting steel plate structures, by both welding and riveting. Thoroughly versed in welding procedures and scheduling of work in both the shop and the field. Graduate engineer. Address S-3, The Welding Engineer.

Sales Engineer and Metallurgist—Desires connection with gas or electric firm. Formerly District Sales Manager of twenty Eastern and Southern states. Highest recommendations. Have following from coast to coast. Address Sales Engineer, 837 West Fulton, Seattle, Wash.

Combination Welder—6 years' experience in arc and gas welding, on all kinds of metals. Will go anywhere for steady position. J. H. Jarvis, 1524 Brown St., Dayton, Ohio.

Combination Welder—Has been gas welding since 1914. Can also handle the arc. Formerly foreman of shop. References. Ben O. Warne, 1845 Nebraska Ave., Chicago, Ill.

Recent M. E. Graduate of a mid-western university wishes to enter the welding field. Min. sal. Address S-1, The Welding Engineer.

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Imperial Brass Mfg. Co., Chicago, Ill.
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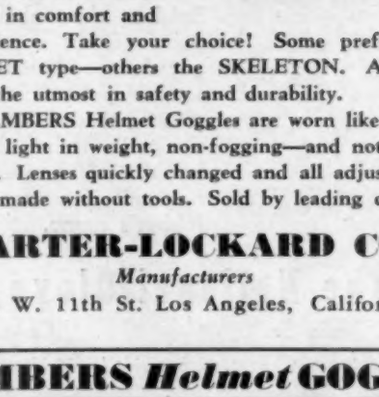

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BUYER'S INDEX
(Continued)

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Hollup Corp., Chicago, Ill.
Imperial Brass Mfg. Co., Chicago, Ill.
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Torchweld Equipment Co., Chicago, Ill.

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SPOT WELDERS
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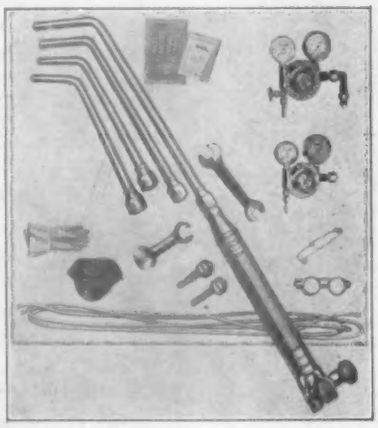

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CONTENTS:

CHAPTER I
The Welding Gases
Introductory — Oxygen — Calcium Carbide —Acetylene — Acetylene Generators — Dissolved Acetylene.

CHAPTER II
Welding Equipment
Regulators — Gauges — Hose — Torches—Goggles—Lighters—Fluxes — Grinders — Sand Blast — Asbestos — Preheating — Equipment — Welding Rods — Testing Welding Rods.

CHAPTER III
Setting Up Equipment
Procedure for Assembling Apparatus—Carbonizing Flame—Neutral Flame—Oxidizing Flame—Preliminary Exercises—Cost Factors in Welding.

CHAPTER IV
Methods of Welding
Thin and Thick Material—Flanged Edges — Rules for Good Welding — Forward Welding — Backward Welding — Rod Manipulation — Double Welding — Vertical Welding — Horizontal Welding — Overhead Welding — Swish Weld — Fadeaway Weld — Welding by Successive Pools.

CHAPTER V
Preparation for Welding
Design — Butt Weld — Caulking Weld — Fillet Weld—Flush Weld—Lap Weld — Strap Weld — Tack Weld — Types of Tank Seams — Bronze Collar Weld — Shear Vee Weld — Beveling — Expansion Preheating — Molds — Dished Patches — Cleaning.

CHAPTER VI
Inspecting the Weld
Penetration — Fusion—Adhesions — Undercutting — Incipient Cracks—Alignment—Buckling — Reinforcement — Hard Spots —Blowholes.

CHAPTER VII
Training Operators
Selection—Shopwork—Preliminary Periods of Training—Practice Exercises.

CHAPTER VIII
Welding Properties of Common Metals
Cast Iron — High Carbon Steel — Chromium Alloys — Manganese Steel — Malleable Iron—Chrome Molybdenum Steel—Aluminum — Monel Metal — Nickel — Lead—Copper—Bronze—Brass.

CHAPTER IX
Testing
Examination of Operators — Tensile Test —Compression Test—Bend Test — Shock Test—Soapsuds Test — Submersion Test —Kerosene Test — Etching Test — Testing the Entire Welding Operation.

CHAPTER X
Important Applications
Tank Welding — Pipe Welding — Sheet Metal Welding — Aircraft Welding — —Brazing — Silver Soldering—Hard Facing—Cutting—Typical Jobs.

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